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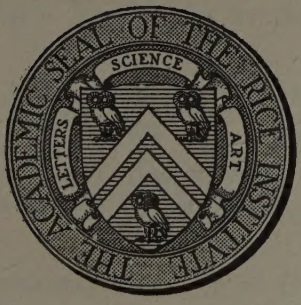

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THE OBLIGATIONS AND PRIVILEGES OF CITIZENSHIP—A PLEA FOR THE STUDY OF SOCIAL SCIENCE[1]

I

PREJUDICES AGAINST THE STUDY OF THE CONDITIONS OF SOCIAL WELL-BEING

REMINISCENCES

A LITTLE more than six years ago, in this Hall, I had the honour and the responsibility of making the first plea for the study of Philosophy in your new Institute, then being dedicated. You made my task very easy. It was in an atmosphere charged with sympathy that I tried to speak of the things which seemed to me to matter most I invited you to no new problems, but I had no final solutions to offer: Philosophy can boast of no such possessions. But still your interest was sustained and your good-will was not spent; for the problems of philosophy are the problems of life, and are therefore new as well as old, always being set and solved though no solution is ever final. We were engaged

[1] Three lectures delivered at the Rice Institute, November 27, 28, and 29, 1918, on the inauguration of the Sharp Lectureship in Civics and Philanthropy.

upon the supreme duty of man, which is to try to know himself. And we were enjoying man's unique privilege; for man's knowledge of himself is the condition of his well-being. Nay, more: it is the structure of his own soul that gives him the clue to the nature of the world in which he lives; for his soul is the medium in which the world breaks into truth, beauty and ultimate worth.

I shall never forget the occasion of our first coming together nor cease to prize it. Before we parted, as you may remember, the level rays of the sinking sun, far flung across the vast and silent prairie, struck through the windows of the Hall, and tinged the walls all around and the very air with colour: the movement of the fans stopped, and there passed into our minds a strange sense of silence and quiet—we felt that passing touch of the fringe of the garment of a peace that is permanent. I thought then, and I know now, that all was well; our unadorned, secular and unassuming service in the Temple of Truth—which this Institute must ever be—seemed to be accepted, as a thing in harmony with purposes that cannot fail. In its own good time there would follow the fitting benediction. The day would arrive when you would give to Philosophy, the mother of the sciences, a place amongst her own daughters. Mingled with their testimony to the diverse aspects of the world without, would be her witness to the world within, and to the wholeness of the Universe and the molten harmony of its many voices. In the meantime, in your organized work in Logic, Ethics and Education you have accorded Philosophy a cordial welcome. And to-day we are here to welcome as cordially the arrival of one of her younger handmaidens. *The Lectureship in Civics and Philanthropy,* which we are inaugurating, will contribute to sound citizenship and wise charity precisely in the degree in which it

faithfully expounds and fittingly applies the fundamental laws of the life of man, which is the central theme of Philosophy.

AND CONGRATULATIONS

It is a little difficult for me to-day to repress the personal note. I should like to tell you how glad I am to be with you once more, how grateful for the renewed experience of your abounding kindness, and how much I value the duty you have placed in my hands to do. But I venture instead to congratulate you on your new academic venture. And, first of all, I would congratulate the donor of the Lectureship, on the munificence of her gift and, still more, on her insight into the profounder needs of her time and the wisdom of her provision of the means of meeting them. Few men, if any, will question the statement that the most urgent problems to-day, the most heavily laden with consequences for the civilized nations of the world, are the problems of social life. These, as Mr. Huxley once said, are "the true riddles of the Sphinx, and every nation which does not solve them will sooner or later be devoured by the monster which itself has generated." But our ways of meeting the demands of our social environment are not ruled and guided by assured knowledge. We treat them as a rule by the bungling and most costly methods of opportunism. Our only resource is the groping empiricism which blunders first and learns afterward—if it ever learns at all. But the Trustees of the Rice Institute in accepting Mrs. Sharp's gift and founding the Lectureship are introducing into one part of the immense social field the serene and severe and secure methods of philosophic enquiry.

I am not able to regard the event as insignificant or this day as ordinary. No one can do so whose creed is the same

as mine—a creed of one article—that human well-being depends on human right-doing, and that doing what is right depends on knowing what is true. You are launching an expedition whose object is to explore the region of issues which are ultimate. You desire, by means of this Lectureship, to begin to find out, and to explain, the forces which make and maintain the structure of human society. You would follow the laws of the working of these forces so faithfully that the Social Sciences shall rival the Physical Sciences in validity and use. It is a great enterprise: possibly the greatest which the Institutions of Research and Learning can ever undertake. It is also very difficult. But I venture to hope that to the teachers and students of this University, as to men of enterprise, the combination of greatness and difficulty in the theme will prove a challenge and an inspiration.

The subject of the short course of Lectures intended to launch your venture is *"The Obligations and Privileges of Citizenship"*; and I have come to the conclusion that the best service I can render is to deal with some of the causes which confuse our sense of these obligations and obscure the privileges. For I have no doubt that, in your country as in my own, even good citizens are often perplexed as to the claims which their country has a right to make upon them, and as to the nature and value of the opportunities of a good life which they can demand of it. The nature of the political State—which in this context "our country" means —and of its relation to its own members and to other States, is but imperfectly known even to those who have enquired. But "the many" have never sought to know. And, so far, men have not realized the marvel of their interrelated life, nor heard the music to which "the Living Temple" of "a World of States at peace" is from age to

age slowly but, I believe, surely a-building. The story of the rise and fall of States is to them but the noisy confusion of clashing sounds—its "fury signifying nothing."

I am reminded of one of the inspired passages in Wordsworth's "Excursion" when I think of the true attitude to the slowly evolving history of man.

> *"I have seen* [he says]
> *A curious child, who dwelt upon a tract*
> *Of inland ground, applying to his ear*
> *The convolutions of a smooth-lipped shell,*
> *To which, in silence hushed, his very soul*
> *Listened intensely; and his countenance soon*
> *Brightened with joy; for from within were heard*
> *Murmurings, whereby the monitor expressed*
> *Mysterious union with its native sea.*
> *Even such a shell the Universe itself*
> *Is to the ear of faith; and there are times,*
> *I doubt not, when to you it doth impart*
> *Authentic tidings of invisible things;*
> *Of ebb and flow and ever-during power,*
> *And central peace, subsisting at the heart*
> *Of endless agitation."*

Let us consider some of the perplexities which prevent the ordinary good citizen from hearing and believing these spiritual tidings, and from finding power and peace at the heart of the endless agitation of his own and his country's history.

Man is never so completely perplexed or so hopelessly bewildered as when some assumption on which he has habitually acted, and which he trusts as a matter of course, breaks down. And our life as citizens is full of such assumptions. It would lead us too far afield to show the extent to which

our beliefs and our behaviour, our inner life and our outward conduct, depend upon ideas which we have adopted we know not when, nor how, nor why, and which we have never thought of examining. Indeed, we do not know that we have ever had some of these ideas in our minds at all. Most men are as little aware of the deeper motives which give to their conduct its main direction, and to their disposition and character their unique qualities, as they are of the cells, fibres, muscles, or physical and chemical changes by means of which they eat and drink and go about the business of their daily life. The "springs" of the inner life are less obvious, more hidden, more complex and more numerous, and the marvel of the movement of mind is far greater than the mystery of the movements of the living body. It would puzzle the most learned of Physiologists to say what different fibres, cells, or nerves of the tongue, or what different use is made of them, when the word "Autocracy" is pronounced instead of "Democracy," or "Capital" instead of "Labour": it would puzzle the Psychologist and the Social Philosopher still more to give an account of the change in the mental activities which results in supplanting the authority of the former in favour of the latter, and its command over a man's sympathies.

Psychology has its own descriptive uses; but it shoves the problems of inner life out of sight rather than solves them when it professes to trace tendencies to a "subconscious region"; and "instinct" is a mere name for the *terminus ad quem* of its explanations. But nothing is "subconscious" so long as we are entitled, or able, to speak of it, and anything may be "subconscious"—say the number of one's toes—if it has never been the object of our thought. Everything that we can know must cross the "margin of consciousness" and it must cross it back again when we think of something

else. But "region," "margin," "crossing," "threshold," are all metaphors that mislead, and there are no such entities as ideas passing in or out of any "field." It is better to recognize, simply, as the plain man does, that both the objects of our thinking and the elements which enter into the operation of thinking are wonderfully complex, capable of being progressively known, and well worth the labour, than to be the victim of words.

As it is an error to divide mind and its contents into regions "conscious" and "subconscious," so it is an error to divide our convictions into those which we owe to "tradition" and those which we owe to "reason," or those which we have made ourselves and those which we have borrowed. Mr. Balfour, in a delightful book, tells us that "Reason" has but little place and power in our lives as compared with "Tradition." He has done injustice to both. It is Reason which forms and transmits and adopts Tradition—nothing but Reason can do these things; and Reason is helpless without some Tradition with which it can agree or disagree and thereby make a starting point for new discoveries. Both Reason and Tradition are ubiquitous in man's experience, and they can act only when they act together.

An easy experiment, which any man can carry out for himself, will show how far we are inheritors of traditions, the validity and value of which we have never examined. Your daily habits, your eating and drinking at table, your ways of dressing, your social courtesies, your methods of doing business, your market manners, the tools you use and your handling of them, show that you have adopted the ways not of Turks or Chinamen but of your own country. When did you summon these items before your mind, compare them each to each and adopt the wiser? You have had little more conscious choice in these matters than you

have had in the colour of your hair. Not that they belong to the "subconscious region," or that you have adopted them without the use of your reason and the exercise of your will, but simply that you have never attended to these mental activities.

Now, the kind of furniture you have in your houses, the chairs you sit on—instead of mats and cushions—the size and shape of the pipe you smoke and the head-dress you wear, are not more your inheritance from your people than are the graver matters of your moral customs and religious creed. When, for instance, and for what reasons did you conclude that Christianity is a truer form of religion than Buddhism, Protestantism than Catholicism, and Calvinistic Methodism (say) better than the whole of them put together? I venture to say that when you adopted the religious creed, the ethical code, the manners and customs of your country, age and hearth, you did it as naturally, nay, as inevitably as you breathed your native air. If you have rejected them since, you have done so with their help, turning them in criticism upon themselves. And the rejection or transmutation, nay, the very criticism of them has been costly. For beliefs and habits are not things which we can put off and on as we please, like our clothing; they are part of the fabric of the soul, and as truly the conditions of rational actions and existence, as the nerves, cells, fibres, muscles and bones are of our bodily life.

It is not a matter of choice whether we shall or shall not borrow the material of our own experience from the community in which we are born and brought up—and borrow without criticising. We *must* have experience before we can examine it, make assumptions before we can test them, live before finding out *how* we live or what for, and we form a character before comprehending the principles

which, being honoured, make it the best, being violated, make it the worst of all things a man can own or be.

What is true of the individual is true of nations. They also live upon assumptions, act upon principles whose truth and practical value they have taken for granted, and at the time when they are making their history rarely if ever know what they do. They bring about results they had not intended nor foreseen, and they often find purposes they desired and attained to be empty, and consequences they feared to be invaluable. Alexander did not forecast the results of his conquests, nor did Cæsar intend to prepare the way for the spread of Christianity. Louis the Fourteenth did not know he was helping to make Britain a great Empire; Napoleon did not intend to create the spirit of the Modern Nation, nor did Germany by her ambitious world-conquest aim at the "permanent peace" of a brotherhood of free nations. Did any nation ever guess what it was doing when making history? The spirit of history operates among the deeper necessities of human nature. Nations, like men, act first and reflect afterwards. There are ages when their spirit is young and full of adventure, and there are periods of reflexion, when they try to gather the meaning of their adventures and to harvest their values. What they garner they leave as traditions for the ages which follow, and their dead selves become "stepping-stones" for the better times and peoples which learn from their experience. Thus do the ages of mankind, in the slow course of its civilization, climb successive headlands, command wider views of a new country whose character they learn as they travel through, and understand, if at all, when their journey is ending.

In this way, too, does man's experience of the past enter into his present. It is in the light of the truths and errors which he gathers from the past that he interprets the new

context into which time has carried him. More precisely, the *"now"* of an individual or a nation is a very complex affair. It is the moving point in which the echoes of their past deeds are converted by them into the calls and cries of the future and into the duties and the opportunities of the present. Man is always reminiscent when he acts: his past lives in him whether he knows it or not; and, on the other hand, he is always expectant—making forecasts, anticipating effects, forming purposes and applying them to what stands around him. He never acts except with a view that a result shall follow. His motive springs from what *is* not as yet, from a good that has to be brought about. But whether that good be real or seeming depends upon his interpretation of himself and of his wise or foolish, wide or narrow experience in the past. Man's history is thus continuous through constant reconstruction, even as natural life is. And if the light falls on his path only from behind, so that he always walks in his own shadow, still he has somehow travelled in the right direction, and the distance he has come since the days when he dwelt in caves and lakes is very great.

But, it will be urged, if it be true that man finds his way though relying blindly on assumptions, why should he endeavour to bring them to the surface and examine them? I answer that most probably if his assumptions proved inevitably valid in every new circumstance he never would examine them. So long as his anticipations turn out true and that occurs which he expects, he goes on his way complacently. But the most placid life changes as it grows old and makes new demands, and the world of circumstance never quite repeats itself. He himself differs subtly from day to day and so does the material on which he works—hence even the things that are true in principle must suffer

change if they are still to guide. The tradition that remains unchanged, the assumption that remains unconscious in its operation, becomes inapplicable, and expectations are falsified. And when the unexpected happens and the expected does not, man stands perplexed. He is forced back for the cause of his disappointment and seeks it in himself. He has made some error: he has omitted some item, overlooked some element, misinterpreted and misused some fact. The blame was somehow his own: for outward events, he knows, take place just as they must do. Until he discovers what has misled him, or which of his opinions were wrong, he is helpless. He refrains perforce from acting, or acts most timidly. An adventurous and progressive life, a life that has in it assault and onset and is not merely on the defensive, which creates rather than repeats and imitates, implies confidence both in itself and in the world which it manipulates. Nothing great was ever done without faith. Faith can move mountains, we are told; but doubt is held to be a sure sign of weakness, and the self-scrutiny that ensues on doubt has been deemed to be a symbol of disease, whether in an individual, or a society, or an age.

"The healthy society," says Carlyle (in one of the earliest of his essays condemning his times), "does not stop to scrutinize itself; to say, How well I perform, or Alas, how ill. Man is sent hither not to question but to work; 'the end of man,' it was long ago written, 'is an Action, not a Thought.' In a perfect State all Thought were but the picture and inspiring symbol of Action: Philosophy, except as Poetry and Religion, would have no being." "The mere existence and necessity of a Philosophy is an evil. Ages of Heroism are not ages of Moral Philosophy. Virtue, when it can be philosophized of, has become aware of itself, is sickly and beginning to decline." What is self-conscious is

artificial, and what is artificial is always inferior. "We have an artificial Poetry and prize only the natural: so likewise we have an artificial Morality, an artificial Wisdom, an artificial Society. The Artificial Society is precisely one that knows its own structure, its own internal functions: not in watching, not in knowing which, but in working outwardly to the fulfilment of its aim, does the well-being of Society consist." (*Characteristics.*)

Carlyle's remedy for the disease of Doubt and Self-scrutiny was action. Faith, Conviction, as he tells us, "were it never so excellent, is worthless till it convert itself into Conduct. Nay, properly, Conviction is not possible till then; inasmuch as all Speculation is by nature endless, formless, a vortex amid vortices. . . . Doubt of any sort can not be removed except by Action. . . . Let him who gropes painfully in the darkness or uncertain light lay this precept well to heart: 'Do the duty which lies nearest thee. . . . Thy second duty will already have become clearer.' " (*Sartor Resartus.*)

If we can recognize the calls of our station in life, fulfil the obligations of our social environment, all is well. Provided the "Kindly Light" falls on the next step of our journey, we need not mind the "encircling gloom." The enviable man and the happy and prosperous nation, and the Golden Age, are so little occupied with themselves, and so far from being morbidly aware of their ill- or well-doing, or from examining their own constitution that, with the healthy servant maid, they say, "Constitution! I *have* no Constitution."

Now, I readily admit that it is possible for a man, and perhaps for a people also, to be unwholesomely occupied with themselves. And wantonly to excite or foster doubt, whether in himself or in others, can be no man's duty. Even those who by conquering doubt have acquired a larger and

a firmer faith must hesitate to disturb the peace of the innocent.

"O thou that after toil and storm
May'st seem to have reached a purer air,
Whose faith has centre everywhere,
Nor cares to fix itself to form,

Leave thou thy sister when she prays
Her early heaven, her happy views;
Nor thou with shadowed hint confuse
A life that leads melodious days."

(In Memoriam.)

By all means let those who can follow Carlyle's lead do so. "Here on earth," he says, "we are soldiers fighting on a foreign land, that understand not the plan of campaign and have no need to understand it; seeing well what is at our hand to be done, let us do it like soldiers; with submission, with courage, with a heroic joy."

But supposing that the one thing which we cannot see is "the duty at our hand to be done," supposing the soldier, fighting in a foreign land, is ignorant not only of the plan of campaign but of the cause and country he is fighting for? Supposing that so far from comprehending the plan, and trusting his commander, he finds no evidence anywhere that any plan exists, or any commander, and sees in the whole struggle nothing but a confused, purposeless, execrable welter? We have seen of late good men in that extremity. Momentous happenings within the inner life of a man—a great success or failure, a deep sorrow, a devastating sin, a consuming hate or disappointed love—may not only disturb old values, and rearrange the order of priority amongst life's aims, but destroy *all* values.

Not only may man's natural life become meaningless, and

his days "pass away as the swift ships," but the moral world itself may cease to matter, and right and wrong be terms not to be used of such a being as he is, a wisp tossed about by homeless winds. "If I be wicked, why then labour I in vain? If I wash myself with snow water and make my hands never so clean, yet shalt thou plunge me in the ditch, and mine own clothes shall abhor me." (Job ix, 29, 30.) Shakespeare was acquainted with deeper doubt and darker despair than Carlyle. *Othello,* so far from knowing his duty, when *Iago* poisoned his soul with doubts of *Desdemona,* bade farewell to the tranquil mind: "Farewell content! Farewell the plumed troop and the big wars! . . . *Othello's occupation's gone!*"—the most pathetic line in Shakespeare, it has always seemed to me.

The problem or the doubt which has serious import for a man, or a nation, or an age leaves us with empty hands. It is not the break up of a more or less superficial set of theoretic opinions, but of principles which not merely guide or rule behaviour but are to the real self or living character as the life-blood that beats in the arteries. No man can live except in virtue of some faith: not even the sceptic. He may be paralyzed by "doubt," and as little capable of adventure in the world of thought or practice as a cripple confined to his bath-chair; but he is not void of all trust, for he is alive. Every man, however simple, or blunt, or "plain," and however free, as he believes, from all theorizing, and guiltless of philosophy, and willing to wait upon experience and "use his common sense," has his own antecedent set of dominating assumptions. His beliefs may be mutually inconsistent, not worthy for a moment to be called a "system," yet they ordinarily act as if they were a system and give him his varying criteria of truth and value. Every man stands at *some* angle of observation from which he con-

templates life, and he assumes *some* "attitude," as we say, towards its opportunities and necessities. However irreflective he may be, he has his *Weltanschauung,* and has been philosophizing, as well as speaking prose, from early childhood onwards. His attitude or outlook has meant for him what his hypothesis means for a man of science. A hypothesis that is false, falsifies everything it pretends to explain; and a change of hypothesis demands the re-interpretation of every one of the facts. So, when a man is gripped by one new truth,—"repents,"—all his old life values are upset. He begins again.

It is evident that such a practical hypothesis, or faith, or background of belief, is by far the most important of all a man's possessions. It may not be his conscious creed, but it is his working faith. It defines the relation of his ends, determines the ranks of his needs, decides the contests of his desires. It is the interpreter of his circumstances and it arbitrates upon their claims. What coheres with it he calls true, what consists with its purposes he calls good. Moreover, it breaks into his conduct, and not in the way of interfering, now and then. On the contrary, its power is consistent and dominant. A man can respect himself in so far as he is loyal to it: it *is* his deeper self. And while a creed may be a dead dogma, a faith that is thus ultimate is, for man or nation, all-powerful.

Now, when such a faith proves false, the cure suggested by Carlyle is both ineffective and inapplicable. Doubts which can be cured by plunging into action are shallow; they are not removed or cured, but silenced. And all doubts which are not faced fester. Moreover, deep doubts leave a man incapable of action: they "paralyze," as we say. Bunyan, in his incomparable way, teaches us a better truth than Carlyle, and offers a better remedy. When *Evangelist*

finds *Christian* in the fields just outside the City of Destruction, distracted with fear "lest the burden on his back should sink him lower than the grave," he says to him, "If this be thy condition, why standest thou still?" He answered, "Because I know not whither to go." When *Christian* reads in the parchment roll, "Fly from the wrath to come," he asks, "*Whither* must I fly?" He could not see the wicket gate even when it was pointed out to him; but he thought he could see some glimmering of a distant "shining light." "Keep that light in your eye," said *Evangelist,* "and go up directly thereto, so shalt thou see the gate; at which, when thou knockest, it shall be told thee what thou shalt do."

Bunyan understood the matter better than Carlyle. When an individual or a nation finds that its past has been spent in the pursuit of a false good, that it has put its trust in error, its first need is truth. In fact, honest doubt is the outcome of a soul's need of a united experience, and usually implies that a new truth is already seeking a place within "the Universe of Belief," and working its way into the system. Convictions are already on their trial when doubt comes, and enquiry is inevitable. Doubt is the soul's struggle for light and air.

Such a discovery of a false faith has been made, in the light of the war, by the civilized nations of the world. They have had convincing evidence that the basis on which their civilization has hitherto rested is insecure. Some fatal error has crept into their methods of dealing with one another. They are groping for new methods, and they recognize that the necessity is urgent: they must either find a better way or perish. Men are everywhere, in the degree of their earnestness and insight, as they stand awed and hushed looking at the wreckage, seeking the means to secure that never more

shall the nations, in their dealing with one another, so lose their way as to find themselves straying with blood-drenched footsteps in the fields of war. They recognize that, in the future as in the past, nations will rise, decline and fall, and that successive forms of civilization shall grow old and pass away even as individuals are born, grow and die: it is so written in their structure. But it is not believed that the nations *must* always live to prepare for battle, and then die at one another's hands. Nevertheless, for the first time in the world's history, it has come to seem possible that by their very inventions the civilized peoples of the earth may bring upon themselves universal ruin: *possible* in the eyes of everyone, *probable* in the eyes of many men versed in man's history, *certain* in the eyes of those who reflect on the motives that make history, *unless the spirit of envy, greed, and ruthless self-assertion perishes and the nations learn the meaning of mutual reverence and regard.* Human life is always tentative, its principles are, at best, hypotheses under the constant strain of test by circumstances; and modern circumstances are such that the nations of the world are too closely intertwined to live the isolated life of selfishness. They must live *for* one another or perish.

These alternatives never before stood plainly confronting each other before the eyes of men. It needed the flare of the flames of war to show the nations whither their path of self-seeking led; and its illimitable sorrows to awaken the sense of their need of one another. Hitherto our politicians, nay, our Statesmen and Foreign Ministers, the Watchers on the Walls of the State, rarely looked beyond the borders of their own country for the conditions of its well-being. It was enough if the horizon of their patriotism extended beyond the interests of their party, or class or constituency. Positive care for the well-being of other nations was held

to be international knight-errantry and the wildest Quixotism. But now, the man who calls himself "plain" and "practical," meaning that he has an unusual stock of common sense, and is not a theorist,—the very last man to learn from experience,—even he has been disturbed. He shares the universal distrust of the ancient ways, so far as to be glad that the means of perpetual peace are being considered. But he thinks that he can go about his business in the old way; and does not realize what averting the possibility of war in future may entail, nor what possible amendments, even in his own manner of going about the petty business of his obscure life, may be required. For the "League of Peace," in which the different states have with such unanimity shown themselves willing to be bound, is significant only if it is much more than an instrument, or a set of regulations limiting armies and navies, reducing armaments and instituting judicial ways of settling differences of opinion and of dispensing justice. These are valuable and necessary as *implements*. But the founding of the League of Nations will prove one of the greatest events in history only if it is a true symbol of a change of mind on the part of the nations. They have, it must be hoped, adopted—though only in part and hesitatingly and timidly and only half-consciously—a new political principle as the basis of their statecraft. The old assumption as to the way to national well-being having proved false, they are now "faintly pursuing" a new light. Having up to the present founded their behaviour on an individualistic faith, each seeking an exclusive good and at best and highest only refraining from injuring one another, they are now bound, in this one matter of ending war, to positive care of one another. They have become partners in the pursuit of a well-being that is common.

It is customary, and I think right, to regard Germany as

mainly, or even solely, responsible for the war. It was premeditated, planned in detail by its rulers, eagerly desired by its military and triumphantly entered upon by the whole nation. Their crime was the outcome of their political creed. They were living out the assumption on which their national life was based in that methodical, thorough and persevering way which is characteristic of that gross and somewhat slow-witted Teutonic people. They were splendidly loyal in spirit and their patriotism would have been magnificent, had it not been worse than blind,—a loyalty to a false, treacherous, and impossible "good."

But, on the other hand, I must say with equal frankness that the assumption which led the German people to seek their country's good by the way of war, has been the assumption on which Great Britain has led its political life. Were I an American, or a Frenchman, or an Italian, I should say the same thing of them *to* them. You will not find in the history of the nations of the world any concern for one another's good, except in so far as it might be instrumental to their own. It has always been indirect, subservient to their egoism. The Nations of the Earth have been unashamed individualists. Not one of them would have hesitated to ask with all the indignation of Cain, "Am I my brother's keeper?" They lay smug and complacent and in perfect peace, wrapped in their self-seeking faith, too *comfortable* to fight. It needed the crude thoroughness of Germany and the terrible tragedy of the war to expose the insecurity of the foundation that national selfishness offered to the civilized life of mankind. So far as I can remember, no politicians or statesmen of any country, on any side of politics, spoke or thought of "Reconstruction" in the sense of changing the principles of political life or revising the basis of international relations.

I do not mean that the better principle was inoperative. The pursuit of a common good, as distinguished from a private and exclusive good, is much older than Christianity. It is as old as morality. It is implied in every union of men, from the most primitive family onwards. The history of the growing power of this principle is virtually the history of the gradual building up of all the institutions of civilization, which culminate in the Political State. In quite recent times there have been examples of designed and deliberate, as well as of unconscious attempts to overleap the boundaries of states and nations, and that not merely on the part of religious enthusiasts. Literature, Music, Science, Industrial enterprise, Methods of economic exchange, the ambitions both of organized Capitalists and of organized Labour, have found these boundaries to be obstacles. But they were regarded as obstacles only because they seemed to stand in the way of their own personal or class advantages. The question of the good of another nation than their own was not raised, except in an incidental and secondary way.

Again, the conception of a permanent world-peace is by no means new. But the prevalent, if not the only form in which it presented itself in the past, was that of the inhabitants of the earth lying tamed and adoring at the feet of some autocratic superior. Germany aimed at that kind of peace. Once Germany was *"über alles,"* and all the nations had put on the livery of its *Kultur* and learned to rejoice in the service of this Teutonic breed of supermen, there would be no more war—unless it had every now and then to be kindled in order to fan the fighting spirit of heroes into flame, and avert the degenerating effects of a perpetual peace!

Perpetual peace is now sought on a wholly different principle. The grip of that principle on the part of the leagued nations is pitifully loose; and the range of its application for a long time to come will be contemptibly narrow. The Economic World, it is understood, is held together by the principle of mutual service, but there is no clear evidence that that principle operates as a chosen purpose in the minds of men, lending moral splendour to their service. On the contrary, the self-seeking of the economic world is undisguised and unashamed, and the opposite principle is recognizably impractical and absurd! There is no talk, so far as I know, of "reconstructing" the industrial and economic world, say, on the model of the family. I have seen no signs that the weapons of economic war, not always more merciful, though often more deadly to him that wields them than those of the battle-field, are to be scrapped, or that the spirit of the "Professions" is to rule the "Trades," or that the reward of service is regarded as a deserved wage. We are not "brothers," nor have we a common "Father," except metaphorically on Sunday. Peace! Where in the economic world is there Peace?

Nevertheless, recognizing clearly the long road that reluctant mankind must yet learn to travel, we can hail the coming of a new light upon its way. The principle of mutual regard, mutual respect, and (in some measure) mutual responsibility amongst the nations is sound. "The nature of things" is at its back. It is invincible. Henceforth the personality of every state, however feeble, will be *theoretically* held to be inviolable, its rights sacred, its wrongs the concern of the united nations; and practice has to follow theory in the end, however lame it may be on its feet. It has been driven home into the minds of politicians and

lawyers—ordinarily the last men to believe in adventurous moral enterprises—that it is not safe for a nation to be alone and that political selfishness does not pay. I admit that this mutual respect for sovereign rights and mutual resolve to maintain them, that the whole attitude of mind as to international obligations, does not, even yet, rise *much* above the *laissez-faire* level. The only positive functions assigned to the League are those of the policeman, judge and executioner. Its motives are preventive and punitive. The moral relations between the different states are so elementary that their international authority, the League, can only say "Don't" and frown,—the method of the mother to the child when it is too small to understand the doing of anything. The nations are not aiming, as yet, at the interchange of those multiform positive services which constitute the main activities and all the virtues of good citizenship *within* a state. The international code of morals is still "Sinaitic." "Thou shalt not" has not been raised to "Thou shalt"—"Thou shalt love thy neighbour, even a little."

An examination of the contents of the ideal as expressed in the proposals of the League would make plain how rudimentary the creed of international conduct is at present, how moderate its aims and how tentative, how little we dare expect the nations to attempt for one another, what coercive securities have to be invented in order to attain that little, and we know already how liable national self-seeking is to limit the range, or frustrate the common purpose. It has taken the nations long to recognize theoretically the ideal which should rule their mutual dealings; there is still to come the conversion of the ideal first into a principle of action, and then into stable custom and

consistent mode of life,—into a *"habit,"* which virtue always must be.

But the pursuit of a good aim, even when it is imperfectly understood, is moral gain at every step. Mere negative respect for one's neighbour's rights naturally grows with the practice of it into regard for his personality, a desire to benefit and serve, and finally into love. The level at which one nation says to another, "I shall not harm you, not because I think it wrong but because to harm you would hurt me," has got its analogue in the founding of crude village communities, if not even in the "instinctive" or semi-brutal love of primitive man for his offspring and his endurance of a fellow savage for the sake of defense: given æons in which to exercise and grow, it will finally become the fairest reality in this world of ours, namely, the self-forgetting love of the dedicated life.

We should not consider it a great achievement on the part of the inhabitants of a village, or of workers in the same shipyard, or even of boys in the same school, if they formally agreed not to attack or rob one another, nor to allow anyone else to attack or rob them. But for some reason which I cannot find, the level of mass-relations is always low, and the lower the greater the mass. The widest communities of all are the nations and states, and "the leavening of that lump" is slow indeed.

Nevertheless, I return to the ground of my confidence. The recognition of the principle of mutual reverence and mutual responsibility between the civilized states of the world is one of the greatest events in man's history. Every stage in the growth of a plant, or animal, or man's soul has its indispensable value, but the planting of the seed and the rebirth of the soul are the most arresting and significant,

especially if the new or reborn life be immortal, as, I believe, moral principles are. There is no final "fall from grace" according to the most rigorous of primitive theology. And our great poets agree:

"There shall never be one lost good! What was shall live as before. . . .
What was good, shall be good, with, for evil, so much good more."

The wickedness of man is not going to have the victory over the goodness that has endowed him with a rational nature: some rift or another, were it that which death makes, will let light into his soul. Had past civilizations perished utterly they would not now be a memory, and a regret, and a warning.

II

SOME UNEXAMINED ASSUMPTIONS THAT HINDER THE STUDY OF THE CONDITIONS OF SOCIAL WELL-BEING

I MUST dwell a little longer on the results we have reached. Some of them have important consequences.

There is no way of accounting for the advance of civilization except on the assumption that, in some way, human history is continuous. A single genuine break, one "incommunicable" gap, would abolish for all succeeding ages all that went before. The unity of mankind must not be regarded as a metaphor or figure of speech. It is real: possibly more real than the unity of the parts of a physical thing, or even of a living physical organism. We attribute a distinct individuality to men and nations, and uniqueness of character, as well as of function, to social institutions. We endow them in fact with the rights, and, therefore, with the privacy of persons. And we do rightly. But it must not be at the expense of their unity in one civilization. They are not individual in virtue of being isolated. Somehow or another, both of these two aspects of individuality and unity, opposite as they seem to be, belong to man and to society; and if we cannot reconcile them in theory as they co-exist in fact, so much the worse for our theory.

Now, this continuity is spiritual. No other is so deep and no other allows such play for the parts. The parts may be free, and free *in virtue of* their continuity! In saying that it is spiritual I do not wish to imply that it is *not* natural.

No such negative holds. At least I have no evidence of what either spirit or nature can do, or be, entirely apart from the other. Taken as mutually exclusive, or solitary, which is the way we usually take them, I believe they are simply fictions. We are entitled to distinguish aspects of reality, but not to break it up. Nature and Spirit are such aspects. And, as we shall see, the most significant distinction between them is that the unity of the concrete whole, as well as its diversity, expresses itself more freely in spirit than in nature.

The most obvious means and symbol of the continuity of civilization is to be found in the borrowing of the ways of thinking and acting of the earlier generation by the later, which we call "tradition." When we speak of tradition we usually seem to imply that "ideas" are handed down from one age to another. These "ideas," we think, are communicated in speech, or they are passed on as printed in a book, or as somehow current in a society or institution. We regard them as a ready-made, and more or less valuable, mental coin, which can be handed down by one mind to another. But this is sheer nonsense; and it is not innocuous nonsense, for it leads to all sorts of mental puzzles and practical difficulties. In the region of mind and character we borrow nothing that is ready-made. We can no more transmit or borrow a true or false idea, than we can borrow or transmit a good or bad act. It must be of our own making. We must achieve the former as we do the latter, by the exercise of our own powers. In reality, an idea *is* an act, and beyond the activity of mind, or surviving it (except as a modification of the thinker), there is nothing. What is handed down in the way of tradition consists of provocatives or incentives, and guides to mental activity. Hence, our inheritance from previous ages consists first of modified

capacities capable of being realized through action, and, secondly, of a more favourable environment for their exercise.

Our relations to the achievements of our ancestors are, at bottom, the same as our relations to the outer world, which presents us only with opportunities, that is to say, with the raw material of thought and action. The opportunities must be seized and used, and the raw material must be converted into instruments of our well-being. Use must be invented by man, and values, of whatever kind, must be created by him. And nothing has ultimate value for man until it is not only a factor in his activities but a part of his very structure. The rose, in order to be red, requires the help of the sun, the seeing eye and the perceiving mind. As isolated, the redness is not in the rose, nor is the perception in the mind. And the same holds of tradition. As long as a community is savage the writings of St. Paul or Sir Isaac Newton are neither true nor false. They have *no* meaning.

It follows that it is an error to attribute the advance of civilization either to Reason or to Tradition. Our attainments can be regarded neither simply as an inheritance, nor as achieved except in virtue of being a gift. We cannot even divide our possessions into two portions, and assign some of them to Reason and others to Tradition, some to previous ages and some to our own. In both the visible world of physical facts and the invisible world of social relations and powers, we both borrow everything we have and are, from that which went before us or is around us, and we also make it. Except an object be "given" to mind, and unless a meaning lies in it, as in spoken sounds or in a book, or a tool, or a social custom, or an institution, mind is helpless, whether for thinking or willing. Nevertheless that meaning cannot be discovered or received except as repro-

duced. And the reproduction is, in truth, the repetition of a mental activity. *And life is this process.* The so-called "world of ideas" and "the moral world" are the process made manifest, like the light of a burning candle. Man is always self-made, and yet the self-made man is (fortunately) a myth—so is a self-made or self-sufficient people. We can no more point to an idea which is absolutely our own or a moral achievement exclusively due to ourselves than we can lay a finger on a part of our body which is not made up of material that has been lent to us for a little while by our mother—the earth, and which we must give up again. Our obligations as citizens are analogous. Our debt to human society and, in particular, to our own country is not measurable. It is as deep as our being: we have borrowed the stuff and structure of our souls.

But there is another aspect of civilization for which Tradition, as ordinarily understood, cannot account, namely, its "advance." Tradition seems to imply repetition and nothing more: but advance, and especially that advance which we call Growth, or Development, or Evolution, implies not only an unbroken identity, but also change, newness, acquisition. So that a Tradition which is alive is both an inheritance and a new creation. Neither man nor the world in which he lives can take a step from what is not to what is. He cannot bridge the gulf between nothing and something. He must start from "conditions" within and without him, and his conditions are not limitations only but also opportunities. The world, at any moment, is a system of possibilities. It exists midway between what is and what is not. It becomes, and its movement, its *only* movement, is from what is implicit to that which is explicit. Nothing begins, and nothing ends, in an absolute sense. A new force is an old force let loose: in every change of form it is "con-

served." The law of causation accounts not for beginnings but for transition. Adam looked out on the world as we see it to-day, and yet that world is not for two moments the same. Nor is the mind which garners its meaning. The past is preserved; and, at least in the mind of man, enriched. Evolution implies a victory over the flux of time. It will not let the past go, but carries it onward. If it is *conscious* evolution—the growth of a soul—then an ideal which is a forecast of the actualized possibilities of the past, moves in the present. The "Tradition" that is handed down must somehow share this kind of vitality. It must continue the same and yet achieve new meaning. Accepted as authoritative, an inherited truth or custom can retain its authority only at the cost of being reinterpreted. When we first adopt the traditions of our people and accept their usages, as we must do in order to live at all, we take it for granted that they are right. But in doing so we interpret them in a way of our own; and to live on them is to adapt them to our needs and ourselves to their conditions. And in this process of applying our assumptions to our circumstances and the needs of life, we discover whether, and how far, they are true or false.

Now, if we sum up these results and endeavour to ascertain their practical significance, we shall find that we are confronted with some of the most perplexing problems of good citizenship. We have stated, in the first place, that all human conditions, whether in the form of theories, or habits and customs, or social relations, are never free from error. And we have seen that even if they were valid in theory and good in practice when first formed, they turn into errors for the ages which come after unless they are changed to meet new exigencies. "Good customs," we are told, "corrupt the world."

Nevertheless, we have affirmed, in the second place, that these traditions, however untrustworthy, are the only available stuff out of which men or states can build their lives. The social world into which they are born and in which they grow, with its constant play of invisible character-forces, is not less indispensable to their life as rational beings, than the outer world is to their bodily life.

Lastly, although the laws of nature are not more sure, nor their demands more rigorous, nor the breach of them more remorselessly punished, than the laws of the spiritual world which we call social; nevertheless it is only in the very process of putting our social views—that is, our traditions—into practice that we can discover what is true and what is false. In a word, to find out whether the stuff on which we live is food or poison we must swallow it. Or, to change the metaphor, light comes too late to lead. We see our path only when we look back.

Now, what judgment must be passed on a scheme which imposes on mankind such conditions of life as these? Is it not the invention of an ironical Destiny? How can moral behaviour be demanded of a being the very premises of whose thought and practice are insecure—not only insecure but both tainted with and tending towards falsehood? Surely, it may be urged, without knowledge of the good (which is the standard of action) it is not possible to distinguish between right and wrong. No doubt *all* human science is tentative. In all departments of knowledge progress comes only through reconstruction. Nevertheless the physical sciences, in the degree in which knowledge grows, become predictive, and thereby guide man's action more and more securely. But the laws of the physical world are stable. Man does not build them up in the process of living as he builds up his social world. Hence the science of man's life

as a moral and social being would seem to be doubly difficult. Moral Philosophy, as even some of its votaries have said, seems to stand solitary in its helplessness. Mankind always at first disbelieves, and it not seldom crucifies its moral prophets. And has it not a right to do so, seeing that, at best, they are but erring interpreters of ever-changing phenomena—expounders of a perpetual flux? Nay, it has been argued that such a knowledge of moral consequences as is certain and unerring would make morality itself impossible. If the moral laws were as clear and as promptly punitive when disobeyed as are the laws of nature, virtue, it is said, would vanish. Obedience would have no merit, and deliberate disobedience would be impossible.

These difficulties are all too familiar to our times. It was not during the war that men found it easy to say:

"God's in his Heaven—
All's right with the world."

Good citizens were, and still are, profoundly perplexed.

At this stage I can hardly do more than suggest considerations that *point towards* a solution. To answer them completely we must expose the unconscious and false presupposition from which the perplexities arise.

In the first place, it is obvious that if man never needed to revise the premises of his conduct, his life would become a tame thing. Morality would lose much of its splendour and all its adventurousness and consist simply of following out plain and inevitable consequences. But the great moment in the life of the thinker is that in which an old hypothesis breaks down and a new one dawns upon his mind. Then do all his facts stand ranked in a new order, as did those of the world of plants and animals for Darwin, and the stars and planets for Copernicus. In like manner, the

great day in a good man's life is that on which, on his road to some Damascus, a new light shines round about him, and on gaining his feet, he asks for work and enters into the service of a better cause. Moral progress demands more than a surface change. What is made to hand falls outside the boundaries of the moral world. Man is responsible for himself through and through.

In the second place, if principles, in their application to circumstances, must suffer change on pain of becoming errors, it does not follow that the change must mean that they are refuted and deleted. It may mean their transmutation, and their persistence in a richer and fuller form. In that case the necessity for change is a benign necessity, and lapful of rewards. Indeed, Evolution verily *is* the most optimistic regulative conception that science and philosophy have ever entertained. Applied to morals, this conception shows us how spiritual principles, in the course of being embodied in tangible ways of a life led in a world of space and time and of physical needs and gains and losses, grow in significance and power by that which they overcome and convert. And, at the same time, they raise the material to which they are "applied" to a higher plane of being. The application of moral principles to natural or physical circumstances injects new values into them—beauty, truth and worth. They are made working partners in the evolution of man.

In the third place, it were well in facing these perplexities that we should reconsider our standard of values. For it is at least possible that "fixity," "changelessness," "eternal immobility" is not the true measure of perfection. Were that the case, every change would be a blunder—the bursting of the bud into flower, the red dawn of a new day, the gradual blossoming of the spiritual powers of the human race. That

which cannot become better *may* not be the best. The perfect may be that which breaks endlessly into new perfections. An exhaustless well of possibilities may be richer than any stagnant lake of fact. In any case the capacity and necessity of growth must not be *assumed* to be a misfortune. And probably no growth can compare in extent and adventurousness and wonder to the growth, throughout the æons, of the soul of humanity. The glory of the world of spirit *is* that it is always in the making. It is the transparent raiment of a living Will.

In the next place, it is also time to renounce the habit of regarding principles and their consequences, whether in the region of theory or of practice, as separate things. They are not entities existing apart. We do not bring forth and then apply the former to the latter, as one foreign thing to another. The scientific hypothesis, even when it first dawns on the mind of its inventor, is not a thing-in-general, or in the air. It appears to him as the inner meaning and ultimate reality of actual facts he has been striving to comprehend. Even as a guess it is not a disembodied universal. In the same way a moral principle is a volition and no mere "idea." It is an active personal force, operating on circumstance. An otiose moral principle is a figment. Principles too high to be applied are vain conceits. They are not moral till they are at work. The love which loves no one in particular, the citizenship that is loyal to no particular community, or is willing to serve only when circumstances are different,—in one word, the duty that is *not* "next to hand"—these are meaningless phrases and nothing more.

A moral duty is an obligation to put *present* circumstances to the highest use. A service which can be postponed is not a duty, as yet. Man is not good because he *was* good yesterday, nor because he is *going* to be virtuous to-morrow. A

moral action is always the application of what is timeless to the fleeting moment—what is eternal flowing into deeds in time.

Finally, the emphasis thrown upon the value of practice by Carlyle and the modern Pragmatist is altogether good. It is undoubtedly true that the practical faith of an individual and, in like manner, the assumption upon which an age or a nation rests its life, are never thoroughly tested, never finally broken, or confirmed, except through being applied in practice. But practice is valuable for precisely the opposite of the reasons which they give. They would make it a substitute for enquiry. By means of it they would arrest the endless questioning of the intellect. As a matter of fact, practice has value only when and because it compels and guides enquiry. Whether in the experimenting laboratory of the chemist or physicist, or in the stress and strain of the inter-human relations of citizenships, so far from making reasoning unnecessary, it summons reason to its task and contributes the main conditions of its successful performance.

Let us follow this matter out a little way, for thereby we may remove one of the misleading notions that block the way of social enquiry. What is it that takes place when, as we say, we apply a hypothesis to facts? Or put a moral, social, or religious conviction into practice? We observe what takes place; we watch the consequences, as we say. That means that we gather new truths by the use of our intelligence. We correct our previous notions of the facts, and we acquire new ones. But all this simply means that we are providing Reason with fuller and more accurate premises from which to draw its conclusions.

There are few errors more common or egregious or mischievous than that of setting up an antithesis between theory

and practice, or reason and experience. No man ever theorized except by the help of facts, nor ever learned from facts except by using his reason, not even when his theory is wrong. As he can neither stumble and fall, nor walk except by the help of the forces of the outer world, so he can not create absurdities without borrowing his data from his environment. Thought no less than action is reaction and response. The reference to the outer object is constant, for from it has been derived all the content of thought. In other words, thought is never pure *a priori* nor pure *a posteriori.* Reason must borrow its content, however wildly it may connect or relate its elements: and to him who leaves his intelligence behind, or ceases to draw conclusions from premises, experience teaches nothing. The most devoted Pragmatist must bring his ears with him if he wishes to hear; and his ears must not be too long.

Men may reason ill or well. They may violate, or honour, or even "transcend" the laws of the logical text-book. In any case they are *always* reasoning. The process of reasoning enters vitally into every intelligent act that they perform. Every judgment, that is to say, every proposition, or intelligent statement, or grammatical sentence containing a subject and predicate is an instance of the use of reason. And all reasoning is an example of the process of evolution: whereby what is indistinct, a mere "something," becomes distinguishable and an articulated whole, a unity of distinct parts, a "system." Except by the use of the distinguishing and connecting powers of reason we cannot name anything or even point to it as a "This" or "That." As the child's whole body participates in digesting its mother's milk, so does his whole rational nature play its part when the child recognizes its mother. And the abstract philosopher or inventive physicist, or the pragmatist who

finds so little use for reason, is no better off than the child. He has no other apparatus at his call. We cannot too often remind ourselves that the distinctions which the psychologist draws become misleading errors whenever they break up the unity of mind, as if only portions of it were rational, or as if reason reasoned only now and then. We reason when we perceive, imagine, conceive, judge, will and even "feel"! Distinctions are degrees and stages—not "isolations." Man never acts in bits. Every cell and fibre of the body enters into every movement: and, much more extensively, the whole rational mind participates in every activity of the spirit.

Hence Reason is coextensive with experience. It does not go before experience, for it must have premises: it does not come after experience, for its premises must be reasonable and in some measure known. They go hand in hand always. Indeed, the functions attributed to experience by those who set it over against reasoning are the most vital parts of reasoning. The most difficult part of reasoning, and, if not the most important, certainly the most unteachable, is that of selecting the premises that are relevant to our interest or purpose. Or to put the same truth in the more usual way, the errors of observation, or of the irresponsible vagaries of an erratic judgment, are both more common and more fatal than those which spring up during "the transit" from the premises to the conclusion. Prejudice, especially as regards matters of high value, is more perverse than "bad logic." Given the true premises, then the arrival at the true conclusion is tolerably easy. Both our reasoning and our practice are in the power of assumptions, and especially of the assumptions we make unconsciously and never think of examining—till we must do so. As we have seen, we "apply" these assumptions in our ex-

perience as a matter of course. We are as much in their power as the mathematician is in the power of his axioms and postulates, or the scientific man of his regulative conceptions, or "colligating hypotheses." They are the cornerstones and supporting beams of our house of life. When they prove false, as they do at times, then "the Palace of music we reared" is gone. We are helpless till we find, once more, the dominant C. Even as the scientific man has to reconstruct his "science" through and through, when one of his ruling conceptions proves to be false, so does the bitterness and bankruptcy of wrong-doing send a man or a people searching for better life purposes.

The pragmatic test, provided it is employed by reason and far-reaching enough, is the old test of every moral optimist the world has ever known. He regards the very entrance of the truth upon the scene as already its triumph: "Be ye of good cheer, I *have* overcome the world." As against error on the other hand, the nature of things proves obdurate. And, possibly, it is in this respect that the use of "experience" and its contribution to right reasoning are most obvious. As an "application" of a presupposition it puts it in relation to a world of facts; and facts "are stubborn chiels that winna' ding." Its inadequacy, if it is false, is exposed. It won't work, or rather it generally works in ways that were not expected. Moreover, it must be observed that experience is the application of facts to facts, not of mere ideas to mere facts. On both sides there is an apprehended content. In acting on circumstances we introduce a new circumstance into their context. Interaction takes place and reveals to him who observes the qualities or nature of the facts. It is only in acting and reacting that qualities of objects emerge. It is what a thing or a man does, or fails to do, which shows its nature, use and value.

In these ways, "experience" ever provides fuller opportunities for reason. It corrects our tendency to accept face values and one-sided evidence. It saves us from thinking abstractly, and committing ourselves to the risky guidance of partial truths. For experience is always concrete: it is the meeting point of the spirit of man and his world. Such is its province and virtue that I am tempted to think that we learn nothing thoroughly except in its school—in life's laboratory, which man's history is from beginning to end.

Germany, for instance—its religious leaders and philosophers, no less than its legal guides and practical politicians—much as it theorized about the nature of the state, trusted a half truth, until its conception of a super-state of supermen was put to a practical test. It put its conceit and its theory of political egoism which was to be tempered in the long run by a loitering benevolence and to endow the conquered world with German *Kultur*—(Bless the mark!)—to the test of experiment. A new light was struck. It has come to seem possible that the old rule of individual well-being may apply to nations also. The nation that would "overcome" the world must "save" the world. The way to Sovereignty is through service. The salvation must go *before* the victory, not after; and the service *before* the sovereignty.

Morality, we have been taught, now, is not the concern of individuals only: nor are there two moralities or endurable ways of life, the one for states and the other for their citizens. On the contrary, men and nations have the same history. They begin at the same time and travel in the same direction. On the threshold of the good life of both alike—just outside the wicket gate, "There is strife among them, which of them should be accounted the greatest." And, in this region of ultimate values, there is only one

way of settling this strife—the way indicated by the greatest of all practical Idealists: "Whosoever shall be great among you shall be your minister."

Human experience has always been murmuring this truth in our ears. But the noisy concerns of nations, which contend for superiority even in times of peace, and the urgency of our physical needs and passions, have dulled our hearing. The men in authority, the spokesmen of the political powers, have been peculiarly unwilling to listen. They can be unselfish in their own affairs and, up to the limits of their power, be at the same time aggressive in the affairs of their state. To them the maxim, "Whosoever of you will be chiefest, shall be servant of all," has seemed preposterous in statecraft. They have known better!

But, to-day, while the echoes of the war are still rumbling in our souls, the principle of mutual service among nations is being reconsidered. It is no longer beneath notice. It may be a creed to be adopted—bye and bye, in a negative way, by some one else first, perhaps, as a possible means of averting another war or at least of postponing it.

Never did a great principle make a more modest appearance and timid entry into human life. But though it is as yet only on our lips, "experience" tends to show that it is valid, and that it will ultimately, as valid things do, become a practical belief. It may break out into the behaviour of states. There are some men already, and some of these are mankind's seers, who are inclined to think that the world may fare better in the power of this principle than in that of its much-tried opposite. The new maxim of international conduct may prove valid, and the Nazarene may prove, after all, to have considerable insight as a practical reformer. "Experience" is enlightening even in politics, given time enough. It compels reflexion, and very

earnest reflexion, whenever our world has gone to pieces in our hands. But it is only *reason* that can reflect and draw the lesson of experience.

Two main considerations have led me thus to dwell upon the assumed opposition of reason and experience: both of them directly applicable to the civic enterprise which has brought us together to-day. In the first place, this assumption has hindered enquiry in the matters which concern the non-material well-being of states and citizens. In the second place, it has stultified that enquiry, where it has been undertaken. Its mischievous results are due to the fact that it arises from, and represents an attitude of mind which renders enquiry *everywhere* in the domain of spirit, or as regards *all* the concerns of man's intellectual, moral, social and religious life, almost fruitless.

The attitude of mind to which I refer is that of regarding all the differences which cannot be resolved into sameness as inconsistent with each other, and mutually destructive. All opposites on this view are contradictory opposites, and all agreement is sameness. The choice of one of the opposites makes the rejection of the other obligatory and absolute. It is an attitude of mind which forecloses the possibility, *first,* that neither of the opposing conceptions may be true; *second,* that neither can have meaning except in relation to its opposite; and *third*, that the opposition implies, or carries within it, the possibility and necessity of a fuller truth in which the opposites find their place as elements within a more or less complex system.

It is a very natural attitude, and as easy as blundering generally is. It seems self-evident that what is convex cannot be concave, that the same motion cannot have opposite directions, that attraction is inconsistent with repulsion, that what is identical cannot change, or that what is the

same cannot be different. But the circle is both convex and concave: it is made by a fixed point and a moving line, and it moves within a plane in every direction. Physics and biology will disprove the other assumptions. And what is evolution except the movement of identity through successive changes, changes whose very differences bring to light the nature of that identity which is the same throughout?

Moral and political questions, and, indeed, all the problems of mind or spirit, are *insoluble* if treated by the methods of final antithesis. If we approach the facts of social life insisting that they shall declare themselves "Either—Or," as ultimate opposites, the answer they will always give is "Neither!" Reason is simply frustrated when it makes such a demand. Its way is blocked, not by the facts, for facts are there to suggest and guide. It is blocked by what it brings with it to the facts: it looks at them through the distorting medium of a false logic. Reason can be stultified only by itself. We blame the nature of things unjustly when we call it unintelligible, and we wrong reason when we call it incompetent. We err through the inadequate *use* of reason, and especially through our reluctance to examine our assumptions.

But we are living in the midst of such antithetical assumptions. The History of Philosophy, which is a true mirror of man's attempt at valid and systematic thinking, shows him to be on every side entangled amongst antitheses. Turn in whatever direction he will, he is confronted with opposites, which, while standing over against each other, call for each other, and need each other as the condition for having any truth. The One and the Many embarrassed Plato; the Universal and the Particular, Aristotle and the Schools which came after; Substance and Quality, Spinoza; Thought and Reality, the Ideal and the Real, Nature and

Spirit, the whole of modern thought. In *Ethics* and *Political Philosophy* we have been tossed to and fro between Freedom and Necessity, Law and Liberty, Egoism and Altruism, Hedonism and Rigorism, Individualism and Socialism, Rights and Duties. Theories of knowing have given a seesaw emphasis on Analysis and Synthesis, Intuition and Ratiocination, Mediate and Immediate, *a priori* and *a posteriori*. Knowledge, Reason and Experience, Logic and Faith, the Intellect and Feeling, Theory and Practice, Form and Matter, Idealism and Pragmatism—and so forth. The *same* antithesis takes all these forms.

There are many reasons why this antithetical attitude comes so easy to us and is so universally invasive. Let me indicate one or two of them.

In the first place, we *must* distinguish in order to make anything of anything—to point to a "this" or "that." For we are placed in a world which is always, so long as we are awake, pressing upon all our senses. Sounds, sights, touches, possible meanings, confusedly wash over us, as if they were seaweed tossed within the waves of an ocean. We must select, separate, exclude; the Sensations which bring even the promise of meaning and use must be singled out. They occupy our minds one by one, serially. And the elementary intelligence is necessarily very discrete. It has to break up its world into very small and simple elements to make anything of them. In the primitive man's soul, sensations, impulses, desires, passions, feelings, volitions pursue one another. There is at first little continuity of either thought or purpose. The range of interest is confined pretty much to the pressing animal want of the moment: vision and aim are alike narrow. Rudimentary man lives in the moment, a life of transient moods, and he is a very thorough Egoist. Universal truths, permanent purposes, practical

ends which are generous and comprehensive and which can give systematic strength and splendour to a whole life, may be there as possibilities but they are far below the horizon. Each particular appearance, as it stands, looks true; for it is corrected by no wide context; and each passion has there and then to be satisfied. Nor is it easy to emerge from beneath the tyranny of the particular, momentary and exclusive. Man is slow to doubt and question his "impressions." It is notorious that the greater the ignorance the stronger the prejudice. The empty mind is by no means the open mind. It has no rival in the sturdy resistance it offers to an invitation to recognize "another side to the case" or another aspect of a fact, or any "rights" which conflict with its own, or sanity in him who urges them.

In the next place, man finds his hands very full at first, owing to the difficulties of meeting the necessities which arise from his physical structure, and which cannot be easily postponed. The body is impatient and its needs are urgent. And, for primitive man, there exists no store either of goods or of social traditions and inventions upon which he can draw. It is with "sides unfed and a houseless head" that the naked wretch abides the pelting of the pitiless storm of nature's forces. What wonder is it that to live at all takes up all the mind that he has, or that he can meet his necessities only one by one? Both his inner world of sensations, wants, desires, impulses, and passions of rage and cruelty and tenderness and pity, and his outer world of facts that interest, seem but a lawless succession of disconnected particulars. His universe is made of contingencies, with too little order in it for any incident to seem miraculous! Its only universal is the need to live, and even that is not a formulated and sustained conscious purpose.

No doubt, in the last resort, the discontinuity is a surface

matter. From a "pure manifold" there could issue neither an orderly world nor a sane intelligence. The most primitive life has *some* stable methods of finding food and shelter: things *do* have the same meaning and the same use, and the little world of the crudest of men is not altogether topsy-turvy. Absolute absence of continuity there cannot be. Even moments of time and parts of space, though they have never happened together or coincided, are not merely exclusive. They are distinctions *within* a unity.

But the outstanding characteristic of the physical world and the life of physical wants and satisfactions is that the *unity* is in the background, implicit and utterly unobtrusive —"Subconscious," if you will: while the differences are urgent, aggressive, outspoken. Hence, when we come to interpret the things which are not purely physical, but vital, sensitive, conscious, intelligent, purposive, volitional, moral, social, we bring with us the ways of knowing with which we are already familiar. We assume without question and quite unconsciously that the phenomena of this more complex region have the same disconnected particularity. We not only distinguish, but disconnect; and in this case to disconnect is to misinterpret and distort the facts.

Even in explaining nature we cannot go far, so long as we regard its facts one by one. Succession and change are taken to have a cause which connects the before and after, and causality implies continuity and permanence. It suggests the conservation as well as the transmutation of energy, and therefore reciprocity and ultimately a closed system *within* which the changes take place, and without which nothing happens. Even Physics drives the enquirer on and on towards fuller and more dominant unity. But when we come to vital phenomena, and, still more, to the phenomena of mind and spirit, the discrete view is arrested

on the very threshold, as an impostor. The independence of the elements does not disappear, but it cannot be for a moment forgotten that it is only *relative*. Mathematics, by counting and measuring the parts of a living organism, will not carry us far. It might help us to know how many cells and fibres there are in each of our organs, theoretical mechanics might help us still more, and chemistry more still. But a surgeon or physician, knowing these matters only, and ignoring the interaction of the interrelated parts of a *living* one, would be a risky practitioner. We treat no animal rightly if we forget that he is living and may be sensitive, and no man rightly if we forget that he is a personality, carrying rights and duties, and intensely one with himself.

As we ascend the scale of existence—or of knowledge—the mutual implication of phenomena becomes always more evident and imperative. The abstractness of merely physical methods, justifiable within broad limits in natural science, becomes more and more intolerable. The "colligating conceptions," as Mill (the Individualist) called the principles that *constitute* particulars, play a more and more significant part. The universals are no longer otiose samenesses but powers that break out into and work in the different parts and elements; and always in a greater diversity and variety of them. The activities of the organs in a living body are those of the living being as one and whole. The body breathes only by means of the lungs, and the lungs act only by means of the organism; and there is the same borrowing and lending between the organism as a whole and the minutest cell.

The errors of the Physiologist or Physician who, like an occasional Surgeon, forgets this active interrelation of whole and parts, and how the well-being of the system is at

stake in every one of its elements, are soon exposed and arranged. But the analogous error on the part of the Psychologist, or Economist, or Moralist, or Sociologist may be long hidden. And the mills of the spirit *seem* to grind slowly. The *moral* effects of moral wrong are immediate; deterioration of character does not delay, pollution takes place at once. But the outbreak of the moral cause into the region of *natural* facts is often enough slow and obscure, and it seems uncertain. "The tabernacles of robbers prosper, and they that provoke God are secure; into whose hand God bringeth abundantly," says Job. And, too often, it is the *natural* evils consequent upon wrong-doing that first arrest attention, and induce reflexion and regret and possibly a change of ways. Provided the dubious virtues of prudence and moderation be in control, Individualism in theory and Egotism in practice will carry a man a long way; and they will carry a State still further, if it is large and strong. For Individualism and Egotism are not sheer error —nothing is, except madness. They are half-truths. They are elements which cannot be left out in a theory of moral and social life. They are constituents of the principles which are essential to right conduct. "Humanity" must be reverenced in our own person as well as in that of others. After all, a moral duty is always an individual's duty, a personal obligation. The doing of it is *his* highest good, and he can postpone it for nothing else in heaven or earth. And he must do it alone. It must be his own action, the expression of his own will, and it must be done because he himself recognizes it as good and is moved only by that conviction. This "private" and unique and independent good cannot be eliminated from morality. But it is an error to assume that privacy, uniqueness and independence imply seclusion!

On the contrary, the Good to do which is my own duty and therefore my highest and only ultimate good, is a *Universal* Good. Moral good is like truth in this respect. It is capable of becoming a *common* possession: because it is valuable in itself, as it stands, and its own complete justification. And it is as good in itself, and not as subservient to his own welfare, that a moral agent performs his duty. In that sense the moral law is impersonal and must be obeyed as such. What comes of the agent through obeying it does not count and is not considered. The good that follows, the benefits that accrue, are an unsought addendum, secured by the world-scheme for the agent: its concern and not his. The *moral* reward of right action is just a deeper spirit of obedience, a willingness that passes into *love* of the law. And this reward is beyond the reach of even the most prudent form of self-seeking. It comes only when the agent, be he an individual or a nation, is merged though not lost in a cause that is universal.

Herein, I believe, lies the clue to the solution of the graver difficulties of citizenship, whether they be theoretical or practical. Individualism and Socialism, Nationalism and Internationalism, Egotism and Altruism in all forms, must be recognized as false and futile when apart. They become true only when they are found to be not merely inextricably intertwined but as impossible when sundered as the convex and concave sides of a circle.

We take up this matter in our next lecture.

III

THE FUNDAMENTAL PRINCIPLE OF GOOD CITIZENSHIP WHICH SOCIAL SCIENCE DEVELOPS AND APPLIES

OUR undertaking in this course of lectures is very modest. We are introducing a subject of study. We are trying to indicate the spirit and the method of enquiry which are most likely to reward research in the region of man's social life, the least known and the best worth knowing of all his dominions. In the first lecture we considered some of the opinions which tend to break the spirit of enquiry in social matters, and in the second we considered some of the assumptions which stultify enquiry, even when it is serious and persistent.

We admitted that social facts are much more complex than physical facts. They are the foci of more elements, and the elements are more intimately intertwined. The relations of men to one another in society are more subtle and more numerous than any others. But over and above the difficulties that arise from this intricacy of social phenomena, there is no other reason why we should not know them with as much precision and certainty as we know physical phenomena. The same mental apparatus lies to our hand, and the facts have the same fundamental character of *inviting* the intelligence to interpret them. They *proffer* the truths that are in them, awakening the senses and exciting man's intelligent interests. And, on the other hand, they obstruct error, by refusing to work on false theories or

by bringing unexpected and undesired consequences. It cannot be insisted too often that the whole realm of what is objectively real, apart from the interpreting intelligence, lacks all the means of attaining itself. It is like wealth which cannot be used. It is "Plenty" seeking for *"Penia* or Poverty," to endow her with his riches. Out of their union spring Truth and Good and all the Arts of Beauty.

As to the uses of the knowledge of social truth, it is not to be doubted that none are greater. The practical stakes are highest in this field. Ignorance of himself, false views of his relations to other men, are more dangerous far than any other blindness or error. Mankind's deeper tragedies never were merely, or even primarily, physical. On the other hand, all that stands between the devastated, hungering, distrustful world of to-day and the "kingdom" which is "to come" is just the unillumined mind and the unchanged will.

If I were asked whose wounds hurt man most deeply in these times, I should not name the criminal whose outrages we abhor: I should name the individual or the institution, whether sacred or secular, which discourages the use of reason on the matters of moral, social and religious life.

Turning to the errors of method, we may say of those which have gone so far in the past to disappoint enquiry and foster distrust of reason, that they spring almost wholly from a wrong hypothesis, or presupposition, as to the nature of social phenomena. Perhaps I should use a more general, if more indefinite term, and call it a wrong "attitude of mind." We described it at the close of the last lecture. Its essence is that it *separates* where it is justified in only distinguishing. It represents differences as mutually destructive, when they are possible only through and by means of each other, and *within a unity*.

We are slow to learn the lesson that the starry heavens, in their motion, hint to us. Are the planets alone poised and stable and safe on their circling ways, because they at once attract and repel one another and are held to the centre from which they would ever fly? Or may not this be a parable full of meaning, a symbol of the supreme law of man's spiritual life, which gains itself by giving itself, finds perfect liberty in perfect obedience, mastery in service, self-realization in self-sacrifice, life in death? Can our "plain," "practical" "business" man who looks at things with his "common sense," and runs for us the economic and the political world, deeming himself free from all theoretic extravagancies,—can he be living, as regards all these matters of our social life, at the Pre-Copernican stage? The evidence all points that way. He does not hesitate to assign complete independence of one another to all the elements of his social world. Individual rights are individual, he maintains, whether the individual be a man or a community or a political state. What is mine is not yours, and what is yours is not mine. Rights are held to be by their nature private and exclusive. Duties are the same: your duties are never mine, nor mine yours. And everyone's duties to himself are deemed distinct and separate from his "duties to others." Property is not less private than the personality to which it belongs. It is, in fact, an element of personality, which without it could have no foothold in the outer world. Deprived of *all* individual rights, a citizen of no state, member of no community, and enjoying none of the rights of a state or community, he could not find a place to sit or stand except on some island over which no flag has ever flown. You may find it wise not to assert your rights in all their extent, but no doubt is entertained as to their sacredness or privacy, whether between nations or between

men, or between a political state and its citizens. Most men do exercise moderation; while maintaining that they can "do as they like with their own," they on the whole pay some regard to the views of their neighbours. But if they refrain from running amok, it is out of their benevolence. "What is mine is mine, what is yours is yours; and both you and I can carry his prey into his own den and share it with his cubs." Such, on the whole, is the theory of the natural law in the economic world. The modern world's practice, in so far as it is not consonant with the theory, throws the bones outside for the hungry jackals, such as charitable and educational institutions. No doubt the individualist struggle is less wolfish in many ways. It is fought in business offices and cabinet councils, and not in the forests amidst wintry snows; and the losers are not slain or starved, except indirectly and quite slowly. Moreover, a wider outlook and clearer foresight bring a certain moderation. The selfishness becomes enlightened. The "sensible man" would not only live but let live; and we hear a moderated Egoism advocated as the safest kind. Nay, "compromise" may be made the rule of the better life—a midway course between "Altruism and Egoism," as Herbert Spencer taught, a prudent mixture of "Individualism and Socialism," an alternation and balance of the rights of self and the rights of others, of our duties to ourselves and our duties to others, a mean between the extremes of selfishness and generosity. But the mean or compromise *is always at the expense of each of the opposites*. They are not reconciled or harmonized in a nobler purpose. The business man who is also a good citizen will go to church on the Sabbath day, and listen not without feelings of comfort and complacency to doctrines about the utter devotion of the self and all its energies, and their unrestrained dedi-

cation to an objective good which is as impersonal as it is imperishable. It is all approved as good in its own place, as an ideal to be put into practice in the next life. But business is business. The practically true theory, to be carried out in the place of business, demands that he should put off these notions, and instead of the flowing robes of charity, put on the business armour of hard and cold steel. It is not as a practical man of business that he can carry out the doctrines which he enjoyed in the church, and which in his own home, with his father and mother and brothers and sisters and wife and children, he *does* carry out, finding therein his greatest happiness.

You will ask, what then can be said against this view, except what is Utopian? Is the practical life of men and women in this workaday world possible on any other theory? Are rights not sacred? Are they not exclusive? Is property not intrinsically private? Are duties not also intensely personal? Would you melt individuals down into a sort of social slush by weakening their rights and generalizing their obligations? What value has a sentimental generosity that does not recognize the rights of others and exact the observance of one's own?

I would answer these questions by admitting freely that in their proper context they are true. I should accord to individuals every *item* claimed for them, in the way of privacy, sacredness, independence and inviolability. I would even extend their rights. *But* I should point out that all these rights that we attribute to persons exist only on a certain condition. And that condition appears to be the exact opposite of their private and individual character. They must be recognized as not less social than they are individual—nay! that they are individual, private, personal, *because in the first place they are social.* Rights are social

institutions. Society creates them and maintains them. Indeed, all genuinely and directly rational characters and possessions are particularized or individually appropriated universals. I am not indulging in paradox: I am trying to express plainly a fact that is too often overlooked. The *truth* which an individual knows is not like an error he may entertain, a peculiar conviction, but a *universal* truth. That twice two makes four is true always for everyone. The just or loving act, in a similar way, is an application of a law that is universal; or rather it is the embodiment or realization of a universal in a particular circumstance by a particular volition. Every volition is unique, and yet every willing of that which is right is the willing of a good that is ultimate, universal, a constituent of the nature of things.

Rights and obligations are thus the conceptions that, in the degree in which they are carried into practice, found and maintain a free society. They are bonds which liberate. And we create and maintain them *for* one another; never in virtue merely of our own enactments. My rights *are* mine because they are accorded to me by the society of which I am a member. Yours are yours not in virtue of your assertion of them, but because the social system to which you belong grants and sustains them. If your rights are violated you appeal to your community. Your country takes *your* part because it is *its* duty, which it owes to itself, to protect its grants and maintain its own institutions. No extent or degree of sheer affirmation by either an individual or an Empire will create rights. Both alike can and do make claims, and a State may support its claims by force; but it is not by that method that rights are created or acquire sacredness. That which is right in itself, as only "the good" can be, must be their essential meaning and substance. Claims can collide. Rights cannot; they strengthen each

other. A society which extends to its citizens genuine rights, thereby widening the compass of their private effective wills and enlarging the significance of their personality, knits them together the more closely and establishes its own powers the more firmly by the same act. On the other hand, he who violates or weakens an individual's rights, reducing his personal stature, so to speak, injures the social system at the same time.

We must conclude then that the view of the plain man, who naturally insists on the privacy of individuality, is abstract. He entertains it naturally, almost inevitably. He has had to hold his own all his life; and he knows his desires, aims and volitions *as* his own, and his actions as their result. He traces the springs of his actions no further. He attributes the same kind of separate individuality to others; and he has no option except to regard society as a result of their coming out of their isolation and entering into relations which are more or less stable. He does not realize that he is, by such a theory, constructing a system by means of centrifugal forces!

Nor does the economic world, seen on the surface, tend to correct his error. It appears to be the scene of an unmitigated "struggle for existence." The ruling purposes which are the active forces are undisguisedly self-referent. Business may be just, and it may even pay to be just, but it cannot be altruistic. You serve society best by prospering in your business as an individual, especially if you prosper fairly. Out of business hours you may be generous, but as a business man you can have no other aim than that of the success of the concern for which you act. Such is the usual view, as we have seen.

But it also is abstract: it is oblivious of the deeper forces which, fortunately, always operate. And these are

all corrective of self-seeking egoism. They prevent the results of business from terminating with the business man's projects, and make him a better builder than he intends. The economic world continues to exist because, in spite of the egoistic motives of the constituents, it is a sphere of mutual services. Whether men want to benefit one another or not in their producing and consuming, their selling and buying, they must appear to, and in the long run they must actually do so. Men seek one another because, apart from one another, they are incomplete. And society lives because no member of it *can* live for himself alone, however narrow and selfish his aims. It will prosper, and the course of its life will be smooth, in the degree in which the members which constitute it adopt its tendencies as their own aims. In order to do so they need not deny themselves anything worth owning. They may and should continue to hold their own, and in every sense maintain the sacred inviolability of their persons and rights. They will protect and preserve the station they occupy and the calling by which they live; but they will dedicate it, and rejoice in it as *means* of social service. Nor will they be the worse "business men" for the inner change.

May it not be the ultimate aim of the study which we are introducing to-day to bring this change about? Your economic community, and my own in Great Britain, would find their industrial and commercial ventures all the more safe and prosperous, and human history would find the seas less tempestuous and the shores less strewn with wrecks, were they taught to read the nature of man and the nature of human society more accurately.

The true social theory is thus neither Individualistic nor Socialistic nor a mixture or compound of these. Neither the individual nor society comes first, nor can either have a

preponderating significance at any stage of their evolution. Their interrelation is too deep and intimate. Priority of all kinds is as impossible for either, as it is for the convex or concave side of a circle. That there cannot be human society until there are men and women, is more obvious than the opposite; but it is not more true. Society comes to be an articulated system only when, and in so far as, it breaks out into individuals which are more or less independent within it. They are its issue, and at the same time it is in them that it is actualized. The relation of the individual to society, or rather to the world into which he is born, is like that of the unborn child to its mother. Of himself the child performs no function. Its vital functions are simply the processes of the mother's life. They pulsate at every instant and at every stage of the formation of its elements and organs. But all the while he is being prepared for independent activities. The day comes when he himself draws his breath, and his own heart sends the blood racing through his arteries. He still suckles his mother's breasts, and is carried around in her arms. But the means of independence grow further; and another day comes when the dependence is on the mother's part, and the provision and protection are the joyous activities of the manhood of her son.

Such in truth is the relation of man's mind to its environment, or of the individual to society. He has no intellectual life of his own at first. He entertains no opinions, either true or false, and forms no judgments. He has not distinguished between himself and other beings or other things, and there is for him neither outer nor inner, subjective nor objective. He has sensations, or rather is himself an undifferentiated confusion of undistinguished sensations. He is "simply a mass of feelings," as we say. The outer world

plays upon him, like sunshine on a meadow, preparing him by nature's marvellous ways for producing some kind of harvest. By and by he somehow learns to distinguish and select. That is, he reacts. But of purpose there is none at first. There is no conception of a self to be satisfied, or of that which will bring satisfaction. His cries are as automatic as the pulsation of his heart, except for the subtle potencies that somehow lie hidden behind them. But the possibilities of intelligent activities are there, and they issue in the discovery of a self and a not-self, and in a growing acquaintance with their meaning. Ultimately there appears a self which, *as mind,* makes him who was the means and medium of the forces of the world, their master. He "has the world at his feet" so far as his interpretation is true. The environment is there to serve his soul, and to acquire value in the service.

It is for the Psychologist to give, or rather to guess at, this history; and to do so, if he can, without pulverizing and petrifying the mind into a collection of instincts, faculties and other fictitious parts. Our interest begins with the more or less recognized relations of the citizen to the community. But the analogy helps. It shows the opinions, the beliefs, the purposes and therefore the wants and even the desires of the community circulating in the soul of the citizen, even as the mother's blood beats in the arteries of her unborn child. He selects, it is true, and values things, and makes a choice. But he selects within a *provided* material, and according to standards of value which, like all the rest of his possessions, he has borrowed. Of independence there is not one jot or tittle in the sense of employing any powers which are his own make, or upon any material which is not gifted to him.

The critic of his environment and censor of the social life

of his day is not merely using gifts he inherited earlier in his life, but he is the organ of his environment in the very act of blaming it. His responsibility is shared by his community, and so are the consequences of his view. His country errs, suffers, acquires and prospers in his actions even as a tree does in its leaves. In a word, his good and ill and his country's are ideally incapable of being sundered. And so far is his individuality from being diminished by the intimacy of his relationship to his community, that it is in truth increased thereby. The significance and value of personal life depend upon the nature and breadth of its purposes. The petty life has petty and secluded interests. The interest of his neighbourhood, his city, his country, thud in the arteries of the good man. The life of the best man we know was not only a benefaction to his age, he lived and died not only for his own times or his own people, but for mankind. Men call such a personality "divine." No one need fear that he will obscure or obliterate his individuality by deepening and extending the range of his services as a citizen and identifying himself with his community.

To demonstrate and to bring about the general recognition of this truth is a practical concern of the deepest importance to a people. It is the essence of your new enterprise and you cannot overestimate its significance.

"Ideas have hands and feet," and conceptions which appear remote from the world's ways of life may change their direction. At first sight one would say that nothing could appear to concern the practical life of the plain man less than the views of the Astronomer. What can the right or the wrong understanding of the size, distance, shape and motion of the stars and planets do for him, as he earns his daily bread? The flatness or the roundness of the earth has no appreciable effect on the surface of the field he is plough-

ing. The recondite researches of science have always, and most naturally, been a puzzle and amazement to the plain man in the past. How could "common sense" approve of Newton making bubbles? But the natural sciences have proved their practical power. We distrust them no longer.

Similar questions and doubts readily arise round the study you are instituting here to-day. To answer them you will require the same passion for truth and the same heedlessness of immediate results as have been shown by the devotees of physical knowledge. But you will require more persistence. There are difficulties to overcome in addition to those which spring from the complexity of the elements and the subtlety of their interaction in human society. These of themselves are sufficiently great. Even if you simplified your problem and regarded the state as a machine, you would have to recognize that in "the social machine" which we call the United States of America or the British Empire, there are millions of parts; and that every part has its own wants, desires, passions, fancies and free will! Verily it is not easy either to comprehend or to run.

But the greatest obstacle that the social sciences have to meet never confronted the physical sciences. If there was inability, owing to previous prejudice, to accept the physical truth when it was declared, nevertheless there was no aversion to it. The "natural man" has no objection to the three angles of a triangle being together equal to two right angles, nor are his desires ranged against the view that Saturn has rings. But it is quite otherwise with the science of social life. It seems to tamper with man's individuality, and to threaten to merge it in society. It seems to explain him away. It dispossesses him of all the furniture of his soul. It proves beyond denial that the very language he speaks is not his own but his country's: he has never invented one word.

"Deprived of this single gift, he would stand mute and helpless amongst his fellows, understanding and understood of no one. Would he be an intelligent being?" (But let me refer you on this matter to my "Principles of Citizenship," p. 94.) The least investigation will show that the tissue of the individual's soul is social in every fibre. The mind with which he thinks, the tools with which he works, the material on which he uses them, the ways and methods of his workshop, the materials of his home, the customs and the practical creed of his hearth, and his wife's ways amongst his children,—they are all the endowments of the same beneficent donor. The dependence of a child upon his mother, bone of her bone and flesh of her flesh as he is, is not more absolute than that of the individual upon society.

But all kinds of influences conspire against the acceptance of this obvious truth, and accentuate the independence and uniqueness of our individuality. In the first place, there is an intellectual propensity in this direction. We necessarily endow every object of our thought and perception with a "thisness." An object is in some respect or another unique, a something with its own qualities, occupying a particular place in time and space. The intelligence can have no object which is not a more or less consistent system or a unity of differences, a thing apart. So that the world seems to be a collection of separate objects, every one of them to some degree independent. In the next place, the physical needs which man feels first and seeks to satisfy *are* relatively discrete, and the life of feeling and sensation is comparatively a flux of fleeting particulars. This means that primitive man lives in and for the moment. He has no long views. His world is very narrow and its constituents are loosely related: he has little knowledge of the laws that govern and unite them. Moreover, the means whereby he

satisfies his needs are scanty. The stores of the savage are very small. And they are, or may be at any instant, a gage of battle. Everything is insecure. There is little property, or sense of it. In a word, his perpetual condition is that of war, either with the intruder, who is always an enemy, or with the nature which scants his necessities. How can he avoid being self-assertive, pitted *against* his world? From such circumstances the growth of a "social" spirit must necessarily be difficult. And there is one more circumstance I must mention in passing, which still further increases the difficulty. The functions exercised by society when it does acquire any standing and strength, appear to be inhibitive; and they are so the more completely the more primitive the society. To the ethically crude man social laws and customs are undesirable restraints. Society can make hardly any demands except negative ones upon rudimentary citizens. They are like little children on the hearth, incapable as yet of positive or constructive action. It is only when the citizens of the State can do much for themselves that the State can undertake positive measures. For the history of the development of States is like that of the living organism: it is a process which both "differentiates and integrates"; it increases the power and independence both of the separate organs and of the organism as a whole. "It is possible," as I have said elsewhere,[1] "that the State grows in power even as its citizens acquire freedom; and that the more free and enterprising the citizens, the more secure the order and the more extensive the operations of the State. The antagonism of the State and the citizen is one of those things taken for granted without being examined, which have done vast mischief in social matters."

[1] "The Working Faith of the Social Reformer," p. 104. London, Macmillan, 1910.

The essential mission of this lectureship is to expel this single error, and to establish the single, opposite truth. Everything would follow from this Copernican change. The Social Sciences as a whole have in the last resort this one function, namely, that of tracing the positive ways in which the destiny of the citizen and his State, and the destiny of different States, are mutually implicated; as only those things can be which are ultimately nothing but different manifestations of one self-revealing, self-realizing spirit,—the spirit of *man,* a spirit far more divine than man has known as yet. To fulfil this function were, I believe, to extract the ethical essence and last meaning of human history. It were to trace a process by which man escapes from the isolation of ignorance and selfishness, which shut him out of the world and deny him all its treasures, and becomes its heir.

There is no doubt as to the self-referent beginnings of man's life, nor as to the difficulties of expanding the significance of the self to which reference is made. It is only very reluctantly, as well as slowly, that we learn how the greatness and goodness of the rational self, all its reality, truth and value, come from what it shuts in rather than shuts out, from what it comprehends as the essential substance of its own well-being. I doubt if we ever would learn this truth were it not for the pains and penalties of the cloistered life of selfishness.

The natural difficulties are great enough, as we have seen. Possibly the *pursuit* of the true and the earnest *seeking* after goodness are such splendid ways of occupying the soul of man as to compensate for the fact that neither the true nor the good lies on the surface, ready-made. For it cannot be denied, that, in ordinary consciousness, we take shadows for realities and realities for shadows. We are equally blind

to our own natures and to the nature of the things around us. The beginning of wisdom for us, therefore, is to renounce all that from this false point of view we seem to know. So universally and persistently has this doctrine of renunciation been taught hitherto, that it has become the key-note of the moral and religious life. Our greatest moral and religious teachers have made the strait way straiter still. They have made "self-sacrifice" the substance, instead of the shadow, of the good life: and they have turned the greatest social reformer which the world has ever known and the most triumphantly peaceful optimist into a "Man of Sorrows."

The moral life of the world has yet to be led out into the sunshine. For what is it, after all, that the bad man or the selfish citizen is asked to renounce; or when have we seen the renunciation of selfishness bring unhappiness, or the doing of the right thing bring sorrow? We are still living in the shadow of an ancient dualism which has represented Nature and Spirit, not as aspects of one reality, not as implying and needing and fulfilling each other, not as one moving and ever self-enriching splendour, but as mutual antagonists. And the ethical and social dualism which infects the thought and practice of citizens of the same State, and of States in relation to one another, is one of the consequences of the wider error.

Were the falsity of this dualism exposed in our Universities and Colleges, the Churches and Schools would follow their example. Let the former *prove,* as the natural sciences prove their hypotheses, that the individual owes to society all that he has and is, all that the child owes to its mother (and even more, according to Plato), then surely something of his social ingratitude will cease. The falsity of individualism, the abstractness of the economic view, the

shallowness of a social doctrine and practice that are competitive, and of a theory of values that is materialistic—herein is another ample field in which true social philosophy may labour. And are there not new ways of social service which the new spirit of social enquiry might discover? And will not the old and well-worn services acquire new values?

I can imagine that the industrial leader, in command of vast material and human resources which he now employs mainly to secure his own profit, might find new happiness in his work, and a fresh spring of inspiration and energy in the thought that he is standing at his station and to its duties *for his country*. He would value his triumphs as the general values his victories; they are the triumphs *of his country*. And I am prepared to believe that the working man, whether he toils in a trade or in a profession, will find his labour sweetened by the knowledge that its fruits are for the object of his devotion, his larger self, his country; which is there in turn for *his* good, its life and welfare being one and the same with his own.

But I must pursue this vision no further. The nature of your quest is quite plain. You are, in this University, taking a part in bringing about practical belief in an ethical social truth: the coercing conviction of a far-reaching principle demonstrated in detail by the careful methods of science, demonstrated so plainly as to leave those who cling to the old error no excuse. You will show how amply it is illustrated in the vast laboratory of human history, as the ultimate cause of its continuity and progress. And the reward of successful labour in this domain will be the peace within the State and between the States for which the world yearns. I can speak of it as Plotinus spoke of a still deeper source of peace:

"It is our true aim and centre. We are always gathered

around it. We may compare ourselves to a Chorus which is placed around a Choragus, but which sings out of tune so long as it directs its attention away from him . . . but when it turns to him, it sings in perfect harmony, deriving its inspiration from him. So it is with us. We are always gathered round the divine (may I say the social?) centre of our being; and, indeed, if we could withdraw from it, our being would at once be dissolved away and we should cease to exist at all. But near as it is to us, often we do not direct our eyes to it. When, however, we do so direct our gaze, we attain to the end of our desires and to the rest of our souls, and our song is no more a discord, but circling round our centre we pour forth a divinely inspired chorale."[1]

After all, there is only one way of serving God: it is by serving one another.

HENRY JONES.

[1] See Edward Caird's "Evolution of Theology in Greek Philosophers," Vol. II, p. 224. Macmillan, 1904.

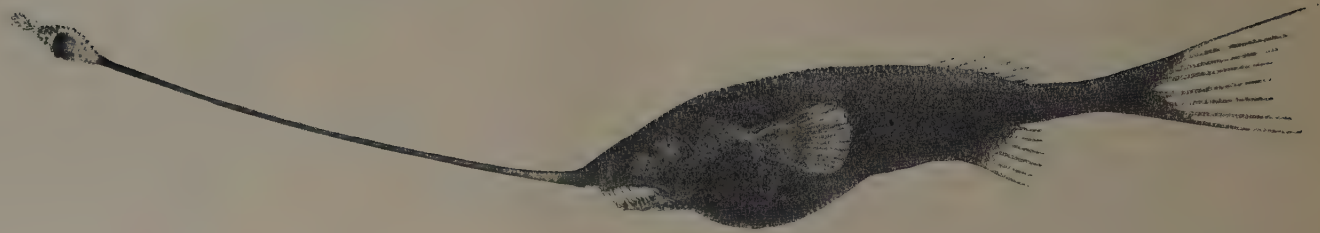
IV

THE DEPTHS OF THE SEA

ALL who have taken any interest in the investigation of the sea during the last years will know the *Michael Sars,* and the work done by her scientific staff in the North Sea. Later she investigated the Atlantic and starting from Norway, she made for the Canaries, from the Canaries to the Azores and thence through the Sargasso Sea to St. John's, Newfoundland, and so back to Glasgow. The ship was built by the Norwegian Government in 1900 to undertake researches into the Norwegian fisheries in connexion with the international scheme of North Sea investigation and to study the conditions under which these fisheries exist. She is essentially a first-class fishing trawler, specially fitted for scientific work. Her length is about 120 feet and her gross tonnage 226. Her engines are 300 horse-power and can keep up a uniform rate of ten knots; but her coal storage is small, a serious consideration when the Atlantic is to be crossed.

There are many reasons for keeping a research ship of this kind small, not the least being the cost of up-keep, but it was somewhat of an experiment to take so small a vessel for a prolonged ocean trip; yet no one who reads the account of the voyage[1] can fail to perceive that the experiment has

[1] "The Depths of the Ocean," a general account of the modern science of Oceanography based largely on the scientific researches of the Norwegian steamer *Michael Sars* in the North Atlantic. By Sir John Murray, K.C.B., F.R.S., etc., of the *Challenger* Expedition, and Dr. Johan Hjort, Director of Norwegian Fisheries. With contributions from Professor A. Appellöf, Professor H. H. Gran, and Dr. B. Helland-Hansen. Macmillan, 1912.



Gigantactis Vanhoeffeni

Western part of Indian Ocean. At depth of 1500 m. × 2.

Macrostomias longibarbatus (*Stomiatidæ*)

Gulf of Guinea. 1880 m. Natural size. Having a light-organ under the eye, 18 between the gill-slits, and on each side 146 in the lateral line and 179 in the ventral line.

proved eminently successful. This is, in our opinion, largely due to the fact that the men of science on board, as well as the crew, were not only exceptionally able men, but were men who thoroughly knew their boat and its capabilities. The list of the scientific staff contains some of the best known names in oceanographic research. Each of them is a master in his own subject, and each is a bold experimenter, and through them new methods and new machinery which were successfully employed on this Atlantic cruise, have been given to the world.

The greater part of the record of the voyage is written by Dr. Johan Hjort; but there are contributions by Sir John Murray, Professor Appellöf, Professor Gran, and Dr. Helland-Hansen. The first chapter is largely an abstract of Sir John Murray's able history of oceanographic research that precedes the summary volumes of the *Challenger* Expedition. The abstraction, indeed, is so complete that little more than a string of names and figures is left, though to some extent the material is brought up to date by the mention of the numerous expeditions which have taken place in the last thirty or forty years. The meagreness of the references to the work done by the steamers belonging to Zoölogical Stations, such as the *Huxley,* by the Fishery Board of Scotland with its steamer the *Gold-seeker,* and by the Irish Fishery Board, is perhaps made good by the recent publication of "The Biological Stations of Europe," by Professor Kofoid, under the auspices of the United States Bureau of Education. Sir John Murray's real contribution to the book is an invaluable chapter of some eighty pages, on "The Depths and Deposits of the Ocean," illustrated by three beautiful plans. This is an authoritative and adequate presentment of a subject which he has made his own.

The passengers and the crew of a liner racing over the surface of the Atlantic are apt to imagine that under them is a vast layer of water of varying depth sparsely inhabited by a few fish. As a matter of fact, the whole of this great ocean is teeming with life. If, instead of taking ship, we could take to the water and walk across the bed of the Atlantic to America, starting from the shores of Western Europe, we should in effect be travelling through a succession of new countries. Not only would the surrounding physical conditions vary as we advanced, but the animal and plant life would vary in correlation with the altering physical conditions. We should soon leave behind us the larger seaweeds of our childhood, such as the bladderwrack, and the belt of mussels, barnacles, limpets, periwinkles, dog-whelks and small crustacea, sea-anemones and worms, which for the most part inhabit the sea-beach between the upper and the lower level of the tide. Just about the limit of low water of high spring tides we should encounter a somewhat richer fauna and flora. In place of the bladderwrack we should find *Laminaria;* also blennies, gobies, and other small fish, together with the larger crustacea such as crabs and lobsters, hermit-crabs and prawns. Clams and scallops would also be seen; while the molluscan whelks and horse-mussels would still occur. Worms we should find crawling in and out of crevices and tubes in the sand, sea-urchins resting on the bottom; or,

"lilting where the laver lingers,
The starfish trips on all her fingers."

Encrusting organisms, such as hydrozoa and polyzoa, are here at work clothing rocks and stones, and shells of other animals. Here, too, will be found an abundance of brightly coloured sponges, while sea-anemones—"those flowering

stomachs," as George Meredith calls them—will be still as plentiful as in the rock-pools left behind.

The nature of this tract would of course vary with the bottom deposit. The fauna we have described in the main belong to a gravel and stone strewn floor. But much the same progressive change in the animal life would be found if we set out on our journey along a rocky outspur running into the sea, with this difference: that limpets would be clinging and barnacles anchored to the rocks. Should we start, however, from a flat and sandy shore, we should miss the large, sessile seaweeds and find instead numerous lugworms and many of the small crustacea such as the copepods. On the whole, the sand supports a poorer fauna, though on the sand the *Zostera,* a vivid green ribbon-like flowering plant, gives its name to the next zone we traverse.

Walking further and further towards the depths of the Atlantic, we should soon lose all sight of the algæ; and the shallow-water fish, the plaice and sole, whiting, skates, dogfish and others, and cod, would give way to the megrim and the hake. The sea-floor would gradually change from rock or gravel or stones to sands, and ultimately to mud or oozes of various tints, their original colours often modified by the action of the decomposition of organic particles in them and on them. All these deposits are derived from the neighbouring land and are blown seaward by off-shore winds or washed down by rains and streams and carried out to the sea by rivers.

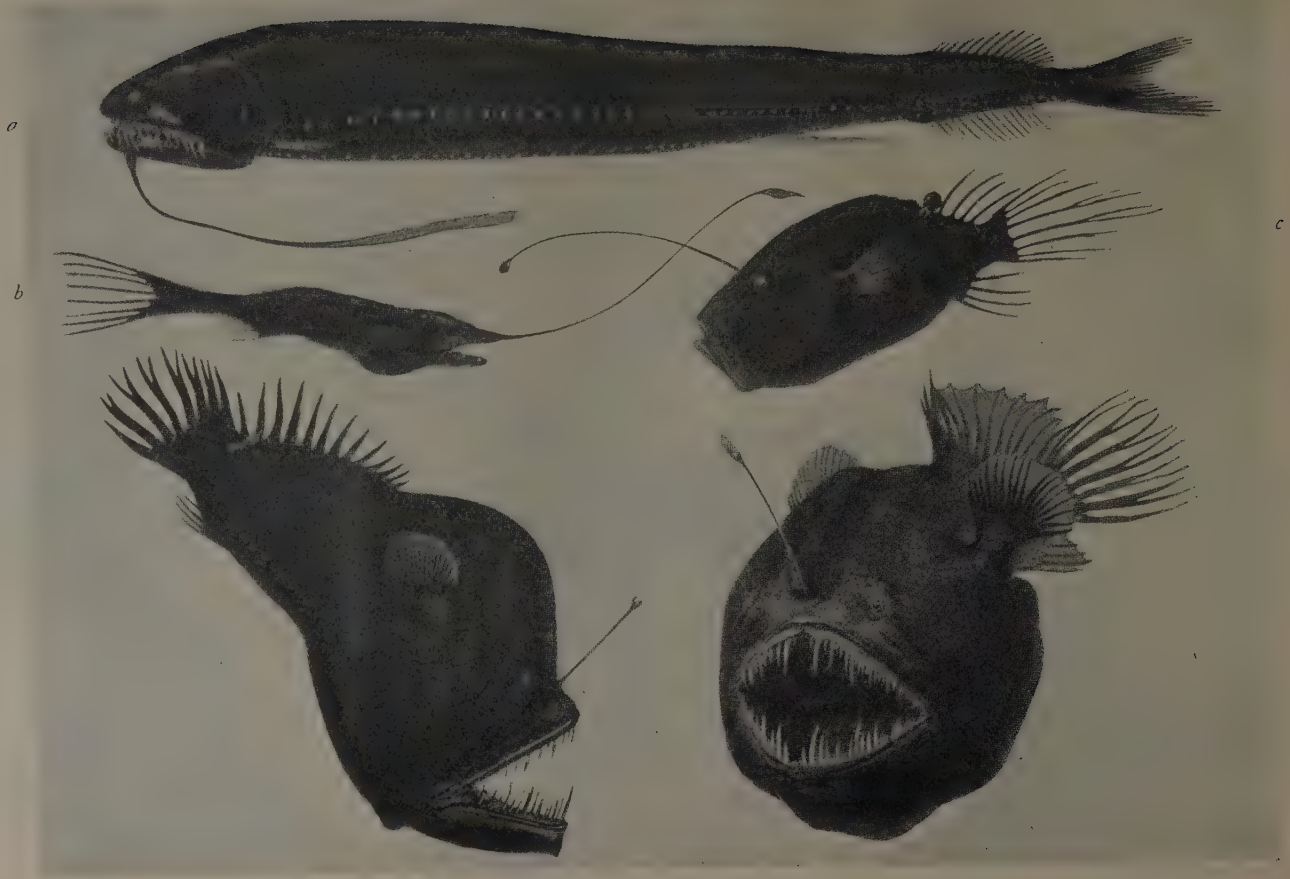
The distance to which fine matter in suspension may be carried is very great. The Congo is said to carry its characteristic mud as far out to sea as 600 miles, and the Ganges and the Indus as far as 1000 miles. Except in the neighbourhood of such great rivers, a subaqueous traveller would soon pass beyond what Sir John Murray has called the

"mud-line," a line that limits the terrigenous deposits everywhere surrounding dry land. Having reached this limit we must proceed warily, for at the mud-line, at an average depth of 100 fathoms, we shall find ourselves at the edge of the *continental shelf,* that rim which extends seaward to a varying distance from all land areas, the rim on which Great Britain rests. Beyond lies the *continental slope,* a precipice more or less abrupt and more or less high, descending by steep declines or terraced cliffs until depths of 2000 fathoms are reached.

The deepest ocean-pit as yet sounded lies in the Pacific. It is 31,614 feet deep, thus surpassing by 2612 feet the height to which Mount Everest rises above the mean ocean-level. Roughly speaking, the heights to which the higher mountains rise above sea-level is paralleled by the depths to which the deepest "deeps" sink below that level. Yet, as has often been pointed out, these inequalities are negligible as compared with the diameter of the earth, and could we shrivel up our globe to the size of an orange, mountain ranges and abysmal depths would be no more prominent than the rugosities of the orange skin. It may be added that if all the elevations on the earth were removed and filled into all the hollows, we should have a world smooth as a billiard-ball and completely surrounded by an ocean 1450 fathoms deep. This is called the "mean sphere level."

The Atlantic has an average depth differing but little from the "mean sphere level." Compared with the other great oceans, it has an unusually large area of comparatively shallow water. Of its total area 27.5 per cent. is covered by water less than 1000 fathoms deep; 18 per cent. lies between 1000 and 2000 fathoms; and 47 per cent. between 2000 and 3000 fathoms; the remaining 7.5 per cent. is still deeper.

At the foot of the continental slope lies an illimitable



Pelagic Deep-sea Fish

a. *Melanostomias melanops* (*Stomiatidæ*). Indian Ocean (near Achin). Trawl to depth of 1024 m. Slightly reduced.
b. *Gigantactis Vanhoeffeni* (*Ceratiidæ*). Indian Ocean (east of Zanzibar). Within depth of 2500 m. Natural size.

Megalopharynx longicaudatus (*Eurypharyngidæ*)
Gulf of Guinea. At depth of 3500 m. ×1.5.

plain, of a uniform dull, greyish-buff colour, flat and featureless as the desert, and only diversified by an occasional as yet uncovered rock or wreck or the straight line of a recently laid cable. This plain continues with hardly a change in scenery or in level until we approach the great mid-Atlantic ridge. As Bruce has shown, this ridge, which roughly bisects the Atlantic, extends from Iceland as far south as 53° of south latitude, with a slight and quite inexplicable break just under the equator. The ridge runs almost parallel with the eastern contour of North and South America, which in turn, as the ordinary map will show, roughly corresponds with the western contour of Europe and Africa. From time to time the ridge rises above the surface of the water, as in the Azores group, St. Paul's Rocks, Ascension, Tristan da Cunha, and Gough Island.

Having ascended the eastern and descended the western slope of this mid-Atlantic ridge, we should again traverse plains of greyish ooze far more extensive than any level land tract known to geographers, and as we approached the American coast we should gradually pass through, in reverse order, the zones of life traversed when leaving Europe. On the eastern coast of America the slope is much more gradual than on the western coast of southern Europe and Africa. Moreover, the terrigenous deposits of North America extend further to sea. This is mainly due to the fact that the winds of the North American coast are, as a rule, off-shore, whereas those of the Old World are mostly on-shore. It is common knowledge that our "weather" comes from the west. Here and there on the wearisome, monotonous scene we have mentally traversed would be seen, half immersed in the ooze, some yet uncovered rock or stone dropped by a passing iceberg, or a piece of pumice thrown out by some volcano, which, after floating about on the surface for a

time, has become water-logged and dropped to the bottom; or, again, the wreckage of men's ships,—

"The wrecks dissolve above us: their dust drops down from afar—
Down to the dark, to the utter dark, where the blind white sea-snakes are,"—

or the bones and skeletons of whales and fishes and sea-birds lie awaiting burial by the ceaselessly falling *Foraminifera.*

If we examine a specimen of the ooze just described we shall find it consists of countless millions of small, microscopic, chalky shells, the innumerable homes of unnumbered unicellular animals, which, when alive, floated on the surface of the ocean. The great mass of these belong to the group of *Foraminifera,* microscopic animals which have the power of secreting calcium carbonate from the sea-water and building it up into shells of many chambers. These shells, compacted together, form the white cliffs of our coasts and the chalk downs of our southern coasts. *Foraminifera* are capable of extraordinarily rapid reproduction, and at times the surface of the sea is almost packed with them. No less than 22,500,000 square miles of the Atlantic bed is covered with the shells of these organisms. Some twenty kinds have been classified. The commonest genus amongst them is the *Globigerina,* and hence the deposit itself is known as *Globigerina* ooze. At what rate the deposits thicken we do not know, but those whose business it is to lay marine cables have evidence that in some places about one inch is deposited in ten years. Like other unicellular, floating organisms, *Foraminifera* are kept floating whilst alive by the secretion of either air bubbles or oil globules lighter than water. When the animals die the floats cease to act and their bodies sink slowly down in a never-ceasing rain of marine dust,

covering and obliterating inequalities on the ocean floor, and clothing the sea-bottom with a mantle of monotony.

These monotonous plains, which Kipling has called

"The great grey level plains of ooze,"

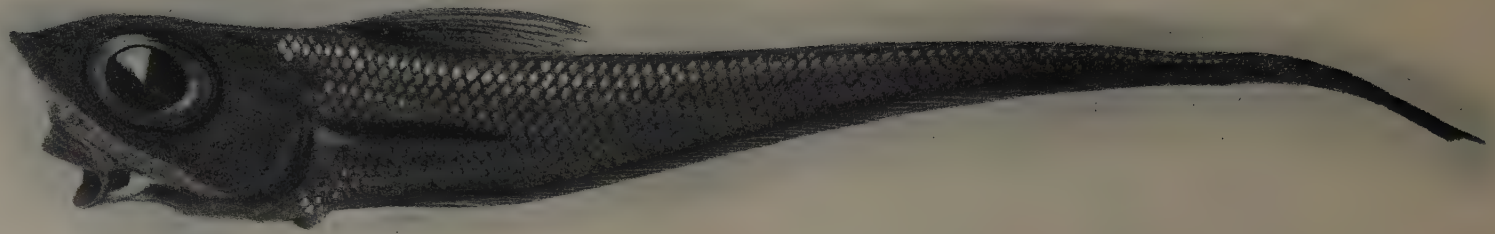
are, as a rule, at a depth of about 2000 fathoms: only in a few places does the Atlantic bottom sink over 3000 fathoms below the level of the ocean surface.

While the main area of the Atlantic is covered by the *Globigerina* ooze, there are a few small tracts off the western coast of northern Africa and around the Azores where this deposit is replaced by the shells of certain floating or pelagic molluscs known as pteropods. Again, there are comparatively large tracts, one forming a wide and irregular ring round the Bermudas, another an irregular patch to the west of the Canaries, in which red clay takes the place of *Globigerina* ooze. Red clay is much more abundant in the Pacific Ocean, and is probably the most widely distributed of all deep-sea deposits. Usually of a reddish colour, at times it passes into a dark chocolate hue due to the presence of a number of small grains of pyroxide of manganese. As a rule, red clay contains little or no calcareous shell matter, but flinty or siliceous organisms, sponge-spicules or the skeletons of *Radiolaria* or of diatomes are often to be found in it. The most constant of its inorganic elements is pumice in all stages of disintegration. Oxides of iron and manganese nodules, either as minute granules or as secretions round other remains, not infrequently attain the size of marbles.

Under certain circumstances, and if exposed for long periods of time, the thin calcareous shells of the *Foraminifera* are soluble in sea-water, and thus it comes about that at a depth of some 2500 fathoms the *Globigerina* shells are dissolved and so never reach the bottom. In their place we

find at depths, say below 3000 fathoms, the bed of the sea covered either with volcanic material or with flinty *Radiolaria* skeletons, or, still more rarely, with a diatome ooze, also siliceous. Like the *Foraminifera,* the *Radiolaria* are unicellular organisms buoyed up by floats of various kinds on the surface of the sea. But instead of secreting a skeleton of carbonate of lime, their skeleton is composed, like that of many sponges, of spicules of flint or silica. This substance is much less soluble in water than chalk, and consequently radiolarian ooze covers a considerable area of the sea bottom in the very deep waters of both the Pacific and Indian Oceans. The second siliceous deposit is distinguished by the predominance of the skeletons of the lowly forms of plant life, the diatomes. This deposit is particularly associated with a band across the north of the Pacific and a great girdle round the Antarctic land.

In describing this imaginary journey across the ocean bed we have spoken of the things we should "see"; but in reality we should see nothing at all unless we were gifted with the power of seeing in the uttermost darkness. At the bottom of the Atlantic a darkness prevails with which the blackest night on land would seem comparatively twilight. No ray of sun or moon can pierce through anything like 2000 fathoms of water, and the only light ever seen at these great depths is due to the phosphorescence of certain of the deep-sea organisms. How far this phosphorescence is visible is still a matter about which we want more knowledge. We know that these luminiferous organs vary immensely in complexity and in power. Many of the lower light-givers (invertebrates) secrete a luminous mucus or slime, but others, especially the fish, have very highly organised luminiferous organs as complex as eyes, and these are segmentally situate, so that in walking across the ocean bed we should



Cœlorhynchus fasciatus Günther (*Macruridæ*)

Agulhas Cape. 500 m. Somewhat reduced.

Young Stage of Fish from the Equatorial Indian Ocean with Stalked Eyes

Within depth of 2000 m. ×9. All specimens have a long appendage in front of the hind fin. On the left is shown the head of a young specimen with shorter and broader eye-stalks—a type which was caught repeatedly in the depths of the Antarctic Ocean.

from time to time see a blurred glare at our feet, like an ineffective lamp in a London fog, and from time to time a fish would pass gleaming from prow to stern with rows of lights, like a miniature liner with her port-holes all aglow.

The poet has told us that:

"The sun's perpendicular rays
Illumine the depths of the sea."

But the poet is only partially right; the sun's rays do not really reach the depths. Till the transatlantic voyage of the *Michael Sars,* the limit to which light penetrated the ocean water was generally thought to be at about 300 fathoms. But Dr. Helland-Hansen, the author of the illuminative chapter on "Physical Oceanography," has devised a new and more perfect photometer than any that has hitherto been used at great depths. At its very first trial, near the Sargasso Sea, the apparatus acted perfectly. As far down as 500 fathoms the photometer registered light, and in considerable quantities; but at a depth of roughly 850 fathoms the most highly sensitive photographic plates were unaffected even after an exposure of two hours. This apparatus is figured on page 249 of the volume, and is obviously a great advance upon anything that has hitherto been used. Very sensitive pan-chromatic plates were used, and the result of the experiments made at noon on the 6th of January, 1910, with a clear sky, "show that a good deal of light penetrates to a depth of 1000 metres—considerably deeper than was previously supposed." At 50 fathoms the rays were of all colours, though red rays were beginning to fade out; at this depth the red rays were, in fact, fewer in number than the green; blue and ultra-violet rays already predominated. At 250 fathoms the effect of the red and green rays was imperceptible even after a long exposure of plates especially pre-

pared to register them. The ultra-violet and the blue rays are those which penetrate deepest. These records correspond closely with the observations of Hermann Foll in his diving expeditions in the Mediterranean. At a depth of 15 fathoms dark red animals looked to him quite black, whilst the green and blue-green algæ appeared lighter in colour. A coloured object of course looks black when untouched by rays of its own colour. In accord with this absence of red rays below 250 fathoms, we find a very large number of crustacea, some of them of considerable size, and all of a most brilliant red colour—scarlet as a boiled lobster—swimming about in the seas just below the lower limit of the penetration of the red rays. As a rule, however, in this region the fish are black in colour, though closely allied species of the same genus, variegated and light in hue, are swimming about in the upper waters.

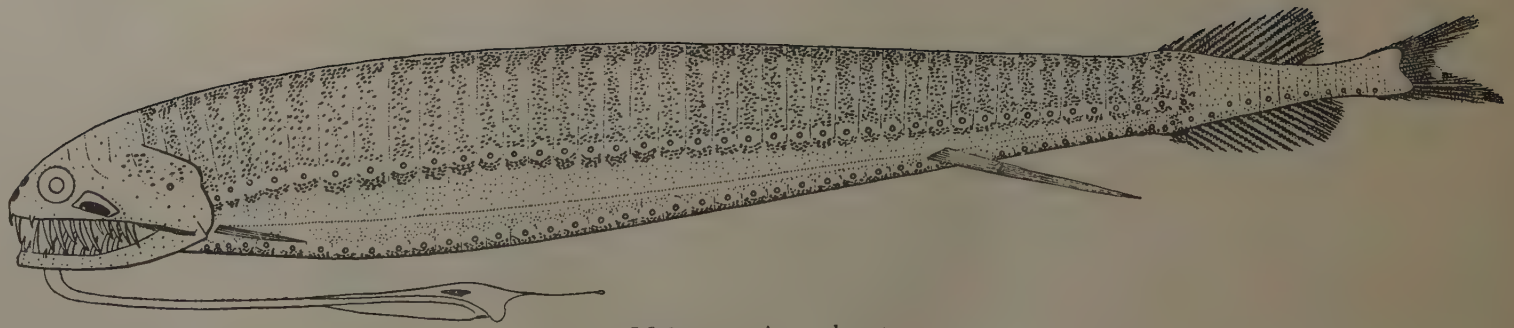
Not only is there no light, but there is no sound at the bottom of the sea except for the rare explosion of a submarine volcano, and even when that occurs the noise must be somewhat muffled.

"There is no sound, no echo of sound, in the deserts of the deep."

Down there all is dark, and all is silent. It is also confoundedly cold. The temperature of even the surface waters of the sea varies comparatively little compared with the fluctuations of heat and cold on land. On land temperatures as low as –90° C. and as high as 65° C. have been registered, showing a range of 155° C. At sea the range is only 33.8° C., lying between –2.8° C. and 31° C. As a rule, at the bottom of the deep sea there is a uniform low temperature. Whether in the tropics or in the polar regions, the bottom of the ocean registers a temperature of between 2° C. and zero,

Malacosteus with Two Pairs of Light-organs

The light-organ located under the eye emits a ruby-red light during life; the hind one is shaped like an eye, lies in a pit, and emits a green light. ×4. South Atlantic Ocean. Within depth of 5000 m.



Melanostomias melanops

1024 m. Indian Ocean near Sumatra. Natural size. Diagram showing arrangement of light-organs.

Light-organs are shown as follows: 1. A large half-moon-shaped movable organ behind the eye. 2. A smaller organ on the gill-cover. 3. A ventral row of 91. 4. A lateral row of 40. 5. Twelve between the gill-slits. All these organs are movable. In addition to these there are countless small light-organs scattered over the body in the arrangement indicated.

though in many places it falls below the freezing-point of fresh water.

These cold waters are, further, very still; at the bottom of the ocean there is a great calm. The waves that churn the surface overhead are unfelt at the depth of a few fathoms; even the great surface currents which stream along the upper waters of the ocean are hardly perceptible below some 200 fathoms. There are, of course—as the wear and tear of cables teach us—places where deep-sea currents are strong; but, on the whole, the abysses of the sea are cold, noiseless, and motionless. The monotony of the surroundings is increased by the fact that no diurnal or seasonal change reaches those great depths. Summer and winter, spring and autumn, are to them unknown; for them there is no such thing as night and day, seed-time or harvest. Probably the inhabitants of these abysses breed all the year round, as land forms do in the tropics. There we find insects and other animals showing no seasonal change of life, eggs, larvæ, chrysalises, imagoes all existing at one and the same time.

Deep-sea animals live at a tremendous pressure. Every five fathoms we descend in the sea the pressure increases by one atmosphere, and at a depth of 3000 fathoms the pressure on each square inch of the body of an animal amounts to three tons, whereas at the surface of the waters it is about fifteen pounds. So great is this pressure that unless special precautions are taken the glass of the thermometers which measure the bottom temperatures is crushed to powder.

It used to be thought that the depths of the sea were uninhabitable, and then again it was thought that could we explore them they would reveal animals known hitherto only as fossils, or perhaps indeed some strange creatures which would come into no class or subdivision of our modern zoölogical classifications. Neither of these conjectures has

proved to be correct. The bottom of the sea is fairly well populated, and, with one or two not very striking exceptions, its exploration has revealed no persistent fossil types, and certainly no forms which do not readily fall into existing zoölogical systems. But the conditions which we have attempted to depict undoubtedly have had a great influence on the structure of the deep-sea animals. Many of them have retained and others have acquired a radial symmetry, and, planted as many of them are in the semi-fluid ooze exposed to a ceaseless shower of *Foraminifera,* they have acquired a certain "stalkiness." This "stalkiness" is shown by many of the cœlenterates and the sponges, by tunicates, and above all by the stalked sea-lilies. Animals with legs and tentacles have in the depths developed longer legs and longer tentacles. In fact, the tentacles are many times the length of the body, and stretch out through the water in all directions, acting in the place of eyes. In the fishes certain of the fin-rays are prolonged and, like the barbels and tentacles, act as sensitive outposts. Many deep-sea animals have become sightless; others, as they approach the bottom, develop larger and more efficient eyes, sometimes standing out from their heads like binoculars, or even borne on the ends of stalks, as is the case in some of the eight-armed cephalopods and in the larvæ of certain fishes.

Many of the fish are black, and, what is more remarkable, they are dark inside as well as out. The cavity of the mouth and of the body are alike lined by tissues of the blackest hue. Others are almost transparent, and, indeed, one can easily read print through the body of a *Leptocephalus,* the larva of the common eel, which is so transparent that one would not be able to see it in a dish but for the presence of pigment in its eyes. But these larvæ pass up to the surface at a very early stage, and their transparency may be due to the fact

that they are destined to a surface life. Many other forms are, however, very gorgeously coloured, and yet, as far as we know, "their glory is concealed," for there is no light and often no eye to note the brilliant blues—the oranges, the greens and reds, the violets and purples—which deck their bodies. Perhaps it may be connected with the temperature at which they live that they show a marked inability to secrete calcareous skeletons: the bones of deep-sea fishes are curiously soft and their scales thin. Their bodies, or muscles, have lost the usual elasticity, and when one pinches a hake, as when one pinches a patient suffering from beri-beri, the mark of the finger and thumb persists. Even the deep-sea sea-urchins present but a soft skeleton, the carapace of the crustacea becomes chitinous, and the shells of the mollusca thin and translucent. Calcareous sponges have not been found in the depths. The exact reason for this deficiency in the power of depositing lime is obscure. It is certainly not due to a lack of material dissolved in the surrounding waters; but it is curious to remark that animals with a flinty skeleton seem to show an increased power of secreting silica in deep-sea waters. Another unexplained peculiarity of deep-sea animals is their tendency to reduce the size of their breathing apparatus. The gills are reduced in number and in size, and in some cases have almost disappeared. There is also a great tendency amongst deep-sea organisms to produce spines and processes—a fact which is recorded over and over again in the specific names which systematists have applied to deep-sea forms.

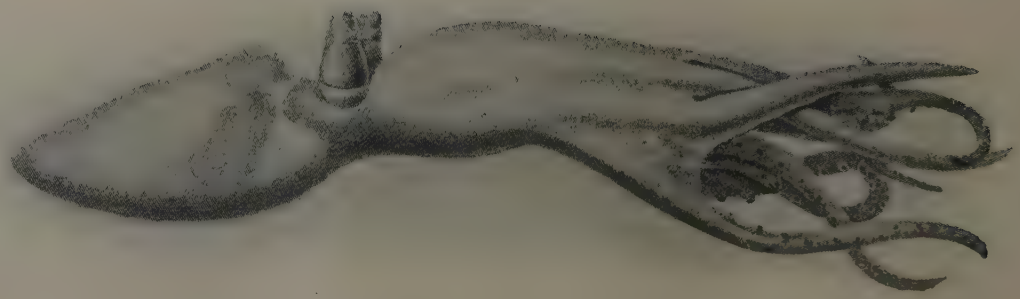
One of the most novel experiments carried on by the *Michael Sars* was measuring, at varying depths, the actual velocity and strength of the current which passes in and out of the Straits of Gibraltar. By the use of Ekman's current-meter, Dr. Helland-Hansen was enabled to add very largely

to our knowledge of the rate at which the upper water sweeps eastwards from the Atlantic into the Mediterranean, and the deeper waters sweep west. Hourly variation was very marked, and at times even the upper current went westwards. These variations appear to coincide with certain tidal movements.

Another remarkable feature of the Atlantic cruise was the number of nets and trawls the *Michael Sars* was able to keep out at once. Sometimes as many as seven or eight or even ten were dragging through the water at different levels on the same line. In this way very large collections were made at certain determined horizons, and these are now being worked out and will be published in full under the auspices of the Bergen Museum. It is interesting to note that the *Michael Sars* in its numerous dredgings found that the contents of the nets were, on the whole, practically identical in character when the nets were set at constant depths. Down to 75 fathoms there were small colourless fish of many species, fish eggs of many sizes, and larval eels in several stages of growth. These were accompanied by a series of transparent invertebrates of the usual pelagic type. From 150 down to 250 fathoms, small silvery fish with telescopic eyes, beautiful to look at but feeble swimmers, drifting hither and thither in the waters, were taken. But perhaps the most numerous of all fishes was a grey *Cyclothone;* and here too were found a number of red crustacea. Between 500 fathoms and 1000 fathoms the grey *Cyclothone* was replaced by a completely black but closely allied species; red prawns were still in abundance, and, what is more remarkable, red chætognaths and red nemertines, and there were also numerous species of black fishes and many dark brown medusæ. In these deeper hauls many animals of great rarity were taken: for instance, the little-known

New Genus of Eight-armed Cuttlefish with Broad Tentacles

East African Coast. 748 m. Half natural size.



Eight-armed Cephalopod (*Amphitretus*) with Telescopic Eyes

Agulhas Current. Within depth of 1800 m. Slightly enlarged.

cephalopod *Spirula* and a species of *Melanocetus,* the type of which was discovered only recently in the Indian Ocean. Other fish were also taken which had hitherto been found only in the Indian or the Pacific Ocean.

One of the triumphs of this expedition was to extend still further the brilliant researches of the Dane Schmidt into the obscure life-history of the common eel, supported as they had been by certain finds of the Irish Fishery Board. The *Michael Sars* captured younger stages of the larva (*Leptocephalus*) than had hitherto been taken; in fact, specimens found south of the Azores, and Hjort says he presumes "that this peculiar distribution can only be explained by supposing that the eel spawns south of the Azores and that the eggs and larvæ pass through their early stages there, being later carried into the North Atlantic and towards the coast of northern Europe by the Gulf Stream."

Although as a general rule the deep-sea forms tend to run rather small, there are exceptions to this, especially in the polar regions. There we find certain isopod crustacea, represented on land by the wood-louse and on our shores by small forms barely an inch long, growing to the size of crayfish or lobsters; while very large pteropods, a group of floating mollusca, which at the surface seldom surpass an inch or two in length, have at great depths been taken over two feet long. Again, a remarkable *Appendicularia,* usually quite tiny, attains at great depths five inches in length with a notochord as big as a lamprey's. Many of these larger forms are found in the polar areas, and not only within the Arctic and Antarctic circles do the deep-sea forms surpass their shallow-water relatives in size, but the bottom fauna in these areas is peculiarly rich both in the number of species and in the number of specimens.

Animals which live at the sea-bottom, or on the shore or

at moderate depths on the continental shelf, so long as they are embedded in the ooze, or attached to stones or burrowing in the mud, or lying on the ground with feeble or no power of locomotion, are known to students of the sea as Benthos. Another category of animals, and a very important one, is the Plankton. The Plankton comprises all animals that *drift*. They may have organs of locomotion, but their powers of movement are entirely insignificant compared with the currents which sweep them along. Few of the smaller ones, swimming as hard as they can, progress more than a few inches a day, and yet, in comparison with their bulk, their locomotor organs are really moving them along as fast as the legs of a cantering pony. Planktonic animals are, however, readily moved by the waves, by the wind, by the tide, but they have little control over their translocation. Now a great deal of the Plankton is confined to the surface of the sea, and here, if we examine the fauna, we shall find innumerable animals of very various kinds. We have first of all a large part of the Plankton consisting of such organisms as *Sagitta,* many marine worms, tunicates, small crustacea such as copepods—some of them as brilliant in colouration and design as any firework—many jelly-fishes, certain molluscs, and a few fish. But most important of all the members of the permanent Plankton are the protozoa and the minute algæ which swarm on the surface of the sea.

These algæ are the source of all life in the sea. They alone are capable, in the sunlight, of building up organic compounds out of the inorganic matter around them, and on them the whole of the marine fauna, from whales to the microscopic, unicellular protozoa, from the surface forms to the abysmal forms, ultimately depend for their food supply.

Then we have a second group of surface Plankton which is composed of the larval stages of fishes, molluscs, star-

fishes, sea-urchins, crustacea, worms, and many other groups. No matter where these animals lay their eggs, their larvæ, as a rule, float to the surface of the water and there drift hither and thither in incredible numbers. When one recalls the fact that the right-whale (*Balæna*), often fifty feet long, and perhaps the largest agglomeration of flesh—or protoplasm—is nurtured on the drifting, floating organisms, one appreciates the fact that the Plankton forms indeed a very large feature in the life of the sea.

One of the most interesting contributions that the *Michael Sars* has made to our knowledge of this surface fauna is by Dr. Gran. He is responsible for a comprehensive chapter on the Phyto-plankton, or the drifting plant-life of the sea. Careful microscopic examination of the bottom of the sea revealed a long time ago certain calcareous rods and plates known as rhabdospheres and coccospheres, little calcareous bodies belonging to microscopic organisms. Systematically these skeletons belonged to organisms on the border-line between animals and plants, and these organisms are so minute that they are only occasionally caught by the finest-meshed nets that sweep the surface of the sea. So minute are they, that to separate them from the sea-water we have to use either an ultra-fine filter or an apparatus known as the centrifuge, which, whirling round at a great rate, is able to drive the solid matter suspended in the water to the furthest limits of the bottom of two rotating test-tubes. In the "Science of the Sea"[1] it is stated that "only the waters of the Mediterranean have been investigated for these forms by methods other than the ordinary tow-nets: it would be of

[1] "Science of the Sea," an elementary handbook of Practical Oceanography for travellers, sailors, and yachtsmen, prepared by The Challenger Society for the Promotion of the Study of Oceanography. Edited by G. Herbert Fowler, B.A., Ph.D., F.L.S., etc., sometime Assistant Professor of Zoölogy, University College, London. With illustrations and charts. Murray, 1912.

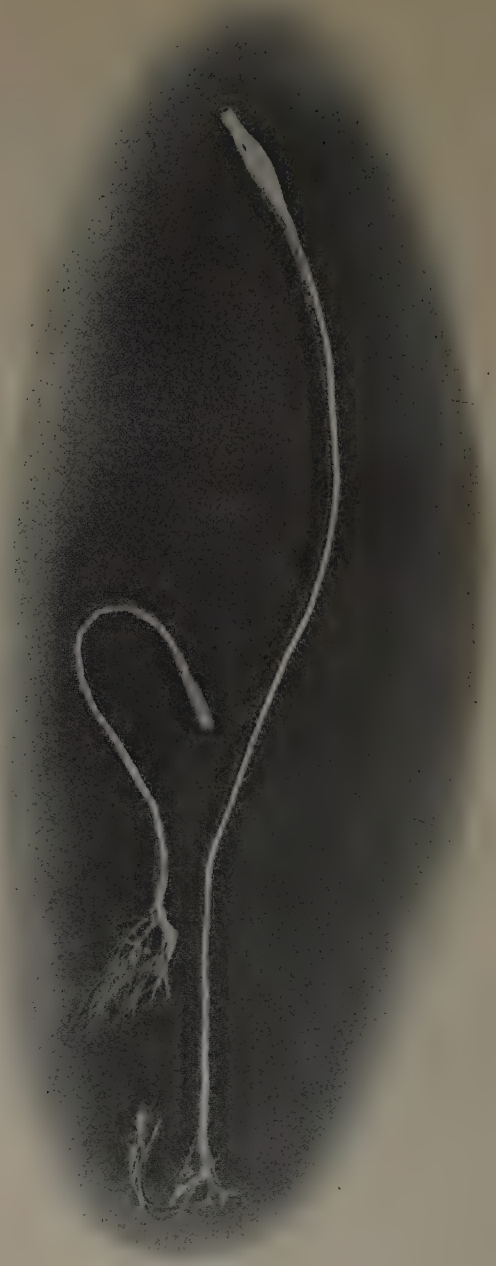
great interest to discover their distribution in oceanic waters generally." This Dr. Gran has done.

On the *Challenger* Sir John Murray used to obtain these microscopic creatures, now known as the *Coccolithophoridæ,* by allowing a glass of sea-water to stand for some hours, when the organisms sank and attached themselves to fine threads placed at the bottom of the tumbler. As we have seen on more than one occasion, organisms of the minutest size have been also discovered by examining Nature's own filter, the pharynx or stomach of the salps which float about in the surface waters. The *Coccolithophoridæ* appear to be abundant in the open ocean of the tropical and sub-tropical waters, but they become rare at temperatures below 45° F. They exhibit a great variety of external forms. And, as Dr. Gran writes, notwithstanding their small dimensions these microscopic calcareous creatures occupy a very important place in the economy of the sea, and their shields of lime, which may be met with in geological deposits dating as far back as the Cambrian period, show that they have retained their shape practically unaltered through immeasurable ages.

They are almost entirely oceanic and mostly belong to the warmer seas. In coastal waters, where the salinity is lower, they are scarcer, but the commonest species, the little *Pontosphæra huxleyi,* has been found even in the Baltic, and there in such immense quantities (five to six million organisms per litre) that the calcareous cells with their strong refraction gave a milky appearance to the waters of the inner parts of the Christiania fiords during the hot summer of 1911. Dr. Gran carried on his investigations on these forms from the Canaries to Newfoundland, and thence across to the Irish coast, and as a result he came to the conclusion that these very minute organisms, which pass with ease through the meshes of the finest silk nets, are far more

Nematoscelis mantis Ch.

Depths of the Atlantic and Indian Oceans. ×6.



Rhizocrinus

East African Coast. 1668 m. × 1.5.

abundant than any others in the open sea, whilst the larger diatomes and the *Peridineæ* appear comparatively scanty in numbers although rich in species.

Dr. Gran made very careful investigations as to the depths to which the surface algæ sink,—the algæ which are the ultimate food supply for all the fauna of the sea. Samples were regularly taken from the surface and at depths of 10, 25, 37½, and 50 fathoms below the sea-level. At depths greater than 50 fathoms algal life was extremely scanty. The maximum algal life appears to lie somewhere about 25 fathoms, which corresponds with what Lohmann had found to be the case with the Mediterranean *Coccolithophoridæ*. This further corresponds with Schimper's observations made in the Antarctic during the *Valdivia* expedition. He found that the maximum of algal life lay between 20 and 30 fathoms, that it totally disappeared below 100 fathoms, and that the great bulk lay above the 50-fathom level.

It has been observed by Hansen that plants in the sea are often so rare that it is difficult to understand how the animals can get enough nourishment, and yet the green and, as a rule, microscopic algæ have to produce enough food to support every single marine animal from the surface down to the deepest abyss. Hansen worked largely with vertical tow-nets, through whose meshes these minute *Coccolithophoridæ* passed with ease. But taking everything into consideration, one would not feel very happy about one's food supply if one were a marine animal and thoroughly understood the economics of the ocean. The margin would strike one as very small.

Lohmann has studied, with the greatest minuteness and care, the quantities of all the Plankton organisms in Kiel Bay throughout a year, and he has calculated the volume of the various groups in the Plankton in the different water masses

of this area at all seasons. In the winter months the algæ seem easily outnumbered by the animals, and from December to February they scarcely form a third of the total Plankton, the floating and drifting living organisms. In the summer months, however, they preponderate and make up sometimes as much as 75 per cent. of the total. He calculates that the plants *on an average* make up 56 per cent. and the animals 44 per cent. of the total drifting organisms in these regions—not a very large margin of safety for the animals.

It should perhaps be mentioned that much of this floating Plankton is, like the abysmal fauna, highly phosphorescent and is indeed the phosphorescence with which we are all familiar. It was surface phosphorescence that the ever-observant Pepys noticed when he described the "strange nature of the sea-water on a dark night, that it seemed like fire upon every stroke of the oar."

Between the floating Plankton on the surface and the inert Benthos at the base of the ocean, be it shallow or deep, are a number of actively swimming organisms—mostly fish, but also cuttlefish, whales, seals, dolphins and porpoises, crustacea, a few worms and medusæ, and a certain number of members of less well known groups. These forms are capable of swimming strongly and making headway against effective currents or tides and are collectively known as Nekton. They not only traverse wide stretches of water in the same horizon, but they are capable of descending and ascending vertically, and no doubt at times many of them form substantial additions to the larder of the animals living at the bottom.

During the last meeting of the British Association, which was held at Dundee, a discussion took place about life and the origin of life. Many learned professors expressed their

Homolochunia

Homolide
with
cephalic spines
and claws
on the
fifth pair
of legs.

—

East
African Coast.

—

977 m.
Natural size.

opinions, but nobody seemed very successful in defining life. As far as one who was not there can form an opinion from the reports of the discussions, most of the authorities "came out by that same door wherein they went."

It is not easy to define life—in fact, it has not yet been done. We can only describe life by enumerating the attributes of living matter, and there is one attribute which is rather apt to be overlooked and may have been overlooked at Dundee. This is rhythm. Living matter is rhythmic. From the contractile vacuole of the amœba to the heart of man there is a definite repetition of action at more or less definite intervals, and there is, as Mr. Johnstone has so ably pointed out in his "Life of the Sea,"[1] a rhythm in the ocean.

There is a rhythm of the tide, a rhythm which corresponds with the rise and fall about twice every twenty-four hours, and that is involved in a still bigger fortnightly rhythm corresponding with the full and the new moon; for about halfway between these two phases the tide rises more slowly and to a lower height, and again, just as there is a half-daily and a half-monthly rhythm, so we have a half-yearly rhythm in the vernal and autumnal equinoxes. So regular are these rhythms that the tide is calculated years in advance, for all parts of the world, and navigators rely trustfully on these calculations, and the calculations are not found wanting.

This rhythmical change has impressed itself upon many marine organisms. As Mr. Johnstone reminds us, to keep cockles healthy in aquaria under artificial conditions one must run the water off the tank at least once a day so as to simulate a low tide. *Convoluta,* a small and lowly worm which lives on the sand and burrows beneath it when the tide is ebbing off the beach, kept in a laboratory in vessels of sea-water,

[1] "Life in the Sea," by James Johnstone, B.Sc. Fisheries Laboratory, University of Liverpool. Cambridge: University Press, 1911.

periodically burrows under the artificial sand at the bottom of the vessel when the real tide is normally going out. The phosphorescence of the surface organisms which we have noticed above only comes into play at best some time after sunset. If these surface organisms capable of producing phosphorescence be kept in an aquarium in a dark room, the same remains true. Although they are exposed to no secular change of light and darkness, they only show their lights at a time when the outside world is dark. The same is true, as Gamble and Keble have shown, with the chamæleon-shrimp, which in the sea shows a variety of protective colouring during the daytime, but at night becomes a transparent blue. Hence it is obvious that the tide has produced an effect which is lasting on certain organisms even when they have been removed from their natural surroundings and the tidal influence for considerable periods.

Then again we have a rhythmical change of temperature, which is fairly constant for given places in the sea. About February and March the sea is at its coldest, but it gradually warms up until in August it attains its highest normal temperature. Of course in all these rhythms there are many disturbing features, such as the weather. But these can fairly easily be discounted. Just as we have an annual rise and fall of temperature, so do we have a daily one, the temperature being at its lowest about sunrise, and gradually rising till about the middle of the afternoon. And again, there is a fortnightly rhythm, inasmuch as near the land the sea is warmer in the summer just after the time of new or full moon, and colder at the same periods during the winter.

Other rhythms might be pointed out, such as those dependent on the intensity of sunlight, and on the degree of salinity, which in turn depends to a very large extent on the water circulation of the sea. The pulsing up of the Gulf Stream is

the direct result of this circulation, and affects not only the warmth but the salinity of the waters on our western shores. "The water is saltest when the drift is strongest, in the months of February to June, and is less salt when the drift is weakest, in the months of November to February." All these features have a profound influence on the life of the ocean, and a remote influence on land animals whose ancestry was marine.

A. E. Shipley.

V

PLEOCHROIC HALOES

THE pleochroic halo has been for many years a mystery. Occurring in enormous numbers in certain rocks, more especially in the micas of granites, and exhibiting a strange regularity of structure, it seemed more difficult of explanation the more it was studied. Petrographers put forward many theories to account for its origin. These we have not space to enumerate. Suffice it to say that an explanation was impossible before certain facts in radioactive science became available. We shall briefly refer, first to the appearance presented by haloes, and secondly to the facts which afford the required explanation of their genesis. Finally we shall draw certain deductions not without importance.

The halo is most often to be found in the iron-bearing micas—*e.g.*, in biotite. It presents the appearance of a disk-shaped or ring-shaped mark of such minute dimensions as to be entirely invisible without the aid of the microscope. When carefully measured it is found to possess a maximum radial dimension of 0.040 mm.; but a very large number—the greater number—will be found to possess a radial dimension of 0.033 mm., the larger haloes being, indeed, comparatively scarce. There is always a minute and apparently crystalline particle occupying the centre of the full-sized halo.

Figure 1 shows the appearance of a halo of the smaller size in mica (biotite). The light is being transmitted through a thin section of the rock. It is polarised and the intense absorption of it by the halo is clearly shown. If the

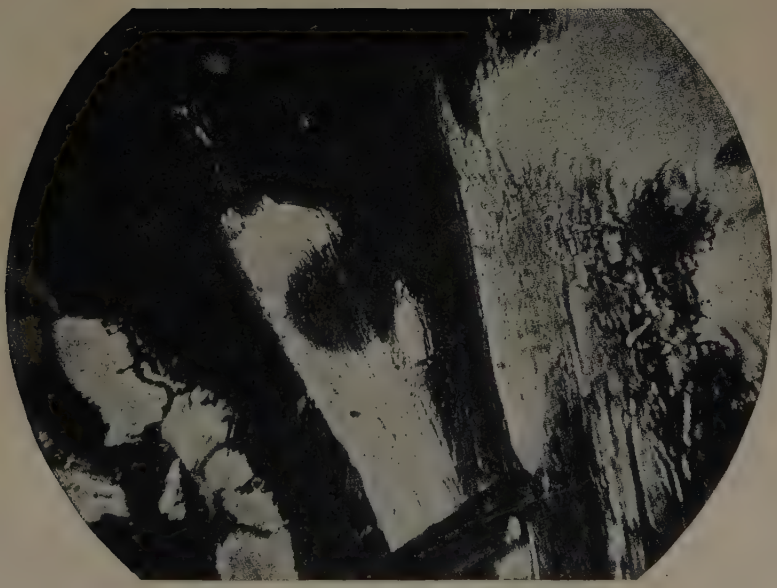


Fig. 1. Halo in Biotite

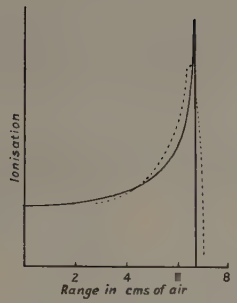


Fig. 2

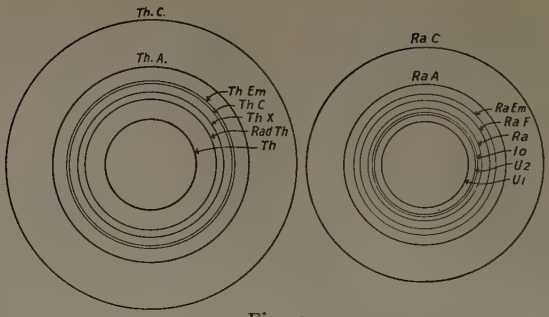


Fig. 3

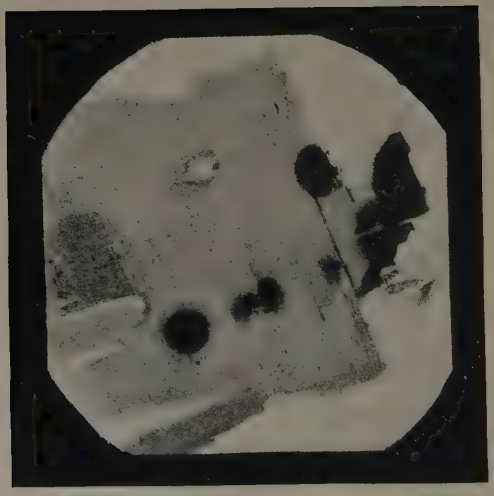


Fig. 4. Thorium and Radium Haloes in Mica

polariser is rotated the halo almost disappears. This remarkable absorption—greatly transcending that of the biotite itself—has given rise to the term *pleochroic halo.*

The regularity in the size of haloes has led to the discovery of their mode of origin. They are a phenomenon depending upon radioactivity. The central particle contains radioactive substances and this fact accounts for the genesis of the halo. How?

The fact that certain rays proceed from radioactive substances when in process of transformation is well known. The nature of the rays has been investigated by many observers. There are three sorts of rays—designated α, β, and γ. The last two do not concern our present consideration. The first is the cause of the halo. It consists of a helium atom expelled from the transforming body with great velocity—a velocity so great that if unchecked it would carry the helium atom round the earth in less than two seconds.

These α rays have been carefully and minutely investigated. When the parent radioactive element, uranium, undergoes its first atomic transformation and becomes uranium 2 an alpha ray is expelled. Uranium 2 in turn transforms spontaneously into ionium, expelling, in the process, a second helium atom. Ionium transforms to radium, giving off yet another helium atom, and so on till eight helium atoms are expelled. The following table embodies these changes:

	Cms.
Uranium 1	2.50
Uranium 2	2.90
Ionium	3.00
Radium	3.30
Ra Emanation	4.16
Radium A	4.75
Radium C	6.94
Radium F	3.77

The numbers given in the table are very important to the subject we are considering. They are the distances in centimetres to which the several alpha rays will penetrate in air of ordinary pressure and temperature. They are derived from measurements made by Geiger. The helium particle, in spite of its great initial velocity, is rapidly stopped by collision with the particles of air or by deflection from its course.

But there is another radioactive family of elements—that which has thorium as the parent substance. In this we may write down a similar table of alpha radiation:

	Cms.
Thorium	2.72
Radiothorium	3.87
Thorium X	4.30
Th Emanation	5.00
Thorium A	5.70
Thorium C_1	4.80
Thorium C_2	8.60

When we compare this table with the former table we see that the most penetrating ray in the thorium family—that attending the transformation of thorium C_2—attains a greater distance in air—8.60 cms.—than does the most penetrating ray in the uranium series—*i.e.*, that of Ra C—6.94 cms. The difference is quite appreciable.

Bragg has determined the penetration of the alpha ray in various media and has deduced the result that the length of path of the ray depends on the square root of the atomic weight of the elements traversed. It matters not how they are combined one with another. This means that, knowing the chemical composition and density of a medium—solid, liquid, or gaseous—we can calculate accurately the distance to which any particular alpha ray will penetrate. Now when

we apply this to the mineral biotite, in which the haloes so commonly occur and the chemical composition and density of which we know, we find that the most penetrating of the rays of the uranium family of radioactive substances would just penetrate 0.033 mm., and the most penetrating of the thorium rays would penetrate 0.040 mm., which distances exactly correspond with the radial dimensions of the two kinds of haloes. This is strong evidence—very strong evidence—that the halo is formed by the alpha ray. The evidence for this view proves conclusive as we proceed with our investigation.

At this stage we may ask whence the generating rays proceed. The answer is, from the small particle always found in the centre of the halo. It has long been known that the central particle of the halo is often the mineral zircon. Now, Strutt has shown that zircon generally, if not always, contains a relatively large amount of radioactive elements. This strengthens our hypothesis. Further, the central particle always appears to be of a nature likely to contain either uranium or thorium.

It will now be apparent that, according to the hypothesis of their radioactive origin, haloes cannot be really disk-shaped or ring-shaped, but must be spherical in form, for the alpha rays are projected in all directions from the central particle. In accordance with this expectation, it is found that no matter in what direction we cut the mica, the halo presents a circular form. The appearance presented is, in fact, that of a section of a sphere or of a sphere seen in perspective. Furthermore, we find disk-shaped marks of small dimensions and not showing the central, originating particle. These are sections taken off the centre of the sphere—what may be called caps cut from the sphere. There is, then, no doubt that the halo is really spherical in form. It is a region

of the mica which has been traversed by the rays proceeding from the central particle and which has, in some way, been darkened by the passage of the ray. We must consider this more closely.

In ascribing to the alpha ray the power of chemically affecting the substance of the mica, we are by no means venturing beyond the probable. For, in point of fact, it is known that these rays can produce changes of a chemical nature in matter which they traverse. In the case of gases we find that ionisation attends the passage of the ray, and the gas in consequence becomes a conductor of electricity. This phenomenon is ascribed to the power of the ray to liberate electrons from the gaseous molecules. Under proper conditions we find, further, that new chemical combinations may be formed and old ones broken up by the ionising activity of the rays. Their power of affecting the photographic plate is nothing more than the demonstration of the chemical effects of these rays in the case of solids. The subject is an extensive one. There is no doubt that the assumption that the darkening of the mica is due to a chemical effect of the alpha radiation activity upon it over long periods of time involves nothing that does not harmonise with our existing knowledge of the properties of these rays.

Bragg has studied the ionising effects of the alpha ray with great care. By special means he has been able to measure this effect at every point along the path of the ray. Figure 2 depicts the general result of his experiments. Bragg found that the ionisation effected by these rays is by no means uniform along the path of the ray. This he demonstrated by showing that the conductivity of the gas was by no means uniform along the path of the ray. He plots the conductivity, or amount of ionisation, vertically, and the path of the ray horizontally. The ionisation is small at first, but

the curve soon begins to rise, and rises with great steepness till a maximum of ionisation is attained just before the ray ceases to act. The dotted line reveals the observed numbers of ions at different points along the path of the ray. All alpha rays do not behave in exactly the same manner, some becoming bent before the final loss of activity. The full line shows the theoretical ionisation produced by a ray which did not bend or become scattered. The cessation of ionisation is in this case quite abrupt.

A highly interesting fact was brought out by Bragg. The effect of the atom traversed by the ray in checking the velocity of the ray is independent of the physical and chemical condition of the atom. He determined the "stopping power" of a medium by the distance the ray can penetrate into it compared with the distance it can penetrate in air. We have already referred to this. We should now notice the fact that this indicates the probability that in any medium whatsoever the ionising power of the alpha ray is exerted somewhat in the manner observed in gases when the investigation is carefully performed. That is, it is small at first, then towards the end of the career of the alpha ray, when the helium atom is about to come to rest, the ionisation rapidly rises in intensity, reaches a maximum, and then drops to nothing with the stoppage of the helium atom and its complete loss of energy.

Now we have already noticed that not one, but many sorts of alpha rays are expelled when uranium and thorium break up into their ultimate products. There are, in fact, in the first case—that of uranium—eight rays varying in range from 0.0118 to 0.0330 mm.; and in the latter case, that of thorium, seven rays varying from 0.013 mm. to 0.040 mm. range. It is evident that the extreme limiting dimension of the halo—assuming the central particle, which contains the

parent radioactive substance and its derivatives, to be very small—is due to the alpha ray of longest range. That is, it will be 0.033 mm. if uranium be the parent substance and 0.040 if thorium be the originating substance. But might we not expect to find some trace of the effects of the rays of lesser range, those which expire within the range of the most penetrating ray? If we strike circles to the radius of the several rays we will understand the question better. (Figure 3.)

From these figures we see that we might expect a very considerable action in the inner part of the halo where the several rays of lesser range do their work. We might, in fact, expect that each ray would tend towards producing a separate spherical *shell* of ionising effect, the outer shell of all defining the limit or boundary of the halo. We might also anticipate that the inner shells would more or less overlap, so that if there was sufficient effect produced by each of the inner rays there would result a more or less general darkening extending outwards to the limit of the range of the ray from radium A, then a comparatively unaffected region, also spherical in form, which should separate the inner from the outer effects. In the section of the halo this should give rise to the appearance of an inner and much darkened disk surrounded by a ring of the darkened mica.

This is just what is observed. In many cases the appearance shown in Figure 4 is presented. Here we see that we can, indeed, differentiate between the inner region crowded with the rays of less penetration and the outer region which is only affected by one ray. The lower halo in the figure scales correctly for thorium. The inner disk is limited by the effects of thorium A; the penumbra-like shading around it is that due to the effects of thorium C only. In Figure 5—much more magnified—we see a uranium halo and we can

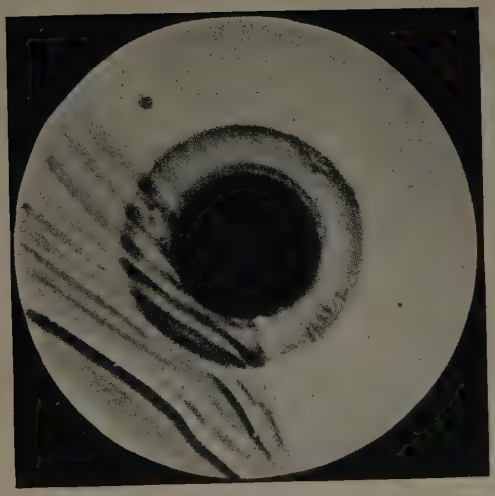


Fig. 5. Radium Halo, much enlarged

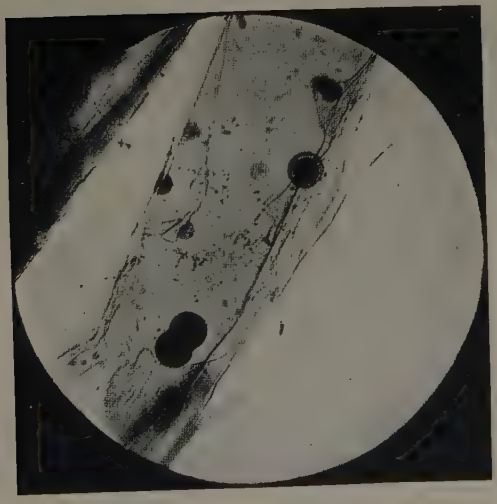


Fig. 6. Haloes in the Mica of County Carlow, Ireland

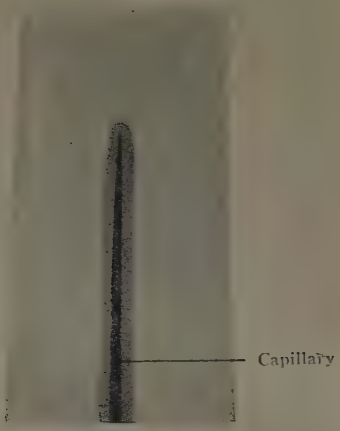


Fig. 7. Halo round Capillary in Glass Tube

Fig. 8. Haloes round Tubular Passages in Mica

here even differentiate between the inner region due to the overlapping effects of all rays out to that of radium emanation, the separate effects due to Ra A, and finally the outermost shell due to Ra C.

The reason for the shell formation is, of course, the marked accentuation of the ionising effects just at the limits of action of the ray. It is, indeed, to be borne in mind that by the mere spreading or divergence of the rays as they get more distant from the centre there will be a considerable weakening of the ionising effect. But even when this is allowed for it will be found that there is an accentuation of the ionisation near the end of the path of the ray. The ring-like structure observed in the sections is, therefore, fully accounted for.

The amount of detail exhibited by a halo is, largely, a matter of "exposure." We may use the term in the photographic sense. The over-exposed haloes are blackened up spheres or disks such as we saw in Figure 1. Lesser exposure enables us to differentiate outer and inner effects, the overlapping and more concentrated trajectories of the inner rays producing an inner sphere of much altered mica, while the region beyond this is comparatively little acted on. Lesser exposure than this may result in the complete absence of visible outer effects. It is easy to find haloes whose genesis is plainly due to the inner rays only. Some of these (see Figure 6) have a limiting radius of 0.012 or 0.013 mm., delicate disks with slightly accentuated outer edge. These are due to the primary alpha rays, those of uranium, which have less penetrating power than any of the others. Again, haloes carried out 0.016, 0.018 and 0.019 mm. are found which may or may not show outer rings, according to the exposure.

A word should be said as to what we mean by "exposure." In photography we may vary the exposure either by varying the duration of exposure or by varying the intensity of the light. Now the haloes found in the same rock formation—*i.e.*, of the same geological origin—may be regarded as of the same age. The duration of exposure has, in fact, been alike for all. A difference of exposure is therefore the result of varying quantity of radioactive material responsible for the halo. It is in harmony with this explanation that the nuclei of the less exposed haloes are always less in dimension than those of more fully exposed ones, the least exposed and faintest haloes often possessing a nucleus visible only to fairly high powers of the microscope.

All haloes are old—exceedingly old. They are not found in modern rocks. The fact is, the quantity of radioactive matter responsible for them is very minute; photographically speaking, the light is very feeble. Hence millions of years—nay, scores of millions of years—have been required for their genesis. We shall presently make some calculations on this point.

Rutherford, incidentally to some work he was carrying out, succeeded in making an artificial halo. He was compressing the emanation of radium into a glass tube of very fine bore. As the emanation decayed the various derived products came into existence and all the several alpha rays penetrated the glass, darkening the walls of the capillary out to the limit of range of radium C in glass. The photograph (Figure 7) is a magnified section of the tube. The dark central part is the capillary. The halo, tubular in shape, surrounds it as a penumbra-like shading. This experiment has been anticipated by many millions of years. We find an exactly similar appearance on cracks in certain micas, as the photograph (Figure 8) shows. Here there

has been, evidently, a passage of radioactive gas or fluid through hair-like channels in the mica.

It is interesting to calculate the number of alpha rays which may have gone to form a halo in the Devonian granite of Leinster, Ireland. It is common to find haloes perfectly developed in this rock with a nucleus of zircon less than 5×10^{-4} cms. in diameter. The volume of zircon is 65×10^{-12} cc. and the mass 3×10^{-10} grams of radium in the nucleus. Now, Rutherford has ascertained that the number of alpha rays expelled by a gram of radium in a second is 3.4×10^{10}. Hence we can show that *three* rays are shot from the nucleus in a year. If, now, geological time since the Devonian is fifty millions of years, then one hundred and fifty millions of rays have generated the halo. If the time has been four hundred millions of years, then twelve hundred millions of alpha rays are concerned in its genesis. The number of ions produced by a single ray is very great. A single alpha ray from Ra C will generate in air 3.37×10^{5} ions.

But haloes of the under-exposed type must be generated by very much less quantities of radioactive matter. The zircon nuclei forming haloes showing the ring due to Ra C very faintly, are often less than 2×10^{-4} cms. in diameter. Such nuclei would expel one ray in five years. The faintest haloes of all may be due to alpha rays expelled only once in a century.

It is evident, then, that the halo enables us to detect an extraordinarily minute quantity of radioactive matter. For we detect the radioactive matter by the slow accumulation of its effects, just as faint stars are detected by long exposure on photographic plates. A very important conclusion springs from this fact. We have said that it is possible to detect and easily distinguish haloes which are derived from the decay of uranium and thorium. These are the only two

parent radioactive substances which are known to radioactive science. True, there is a radioactive parent substance—actinium—which also gives rise to a series of derived bodies. But Rutherford has shown that this substance is probably itself derived from the uranium family—a sort of side-branch. And there is reason to believe that it contributes a quite minor proportion of the alpha rays emitted by the normal descendants of uranium. Its effects would, therefore, be lost probably in those due to the series of alpha-yielding changes which we have already enumerated. But, it may be asked, are there no other primary radioactive substances but uranium and thorium? The halo seems to give a very conclusive answer in the negative. For the sensitive minerals (coloured mica is only one of many which registers the effects of the alpha ray) are scattered everywhere throughout the rocks. Elements of every kind are associated with them both as inclusions or in the external environment. If radioactive elements, other than those of the uranium and thorium families, exist, the halo must show their effects. If present even in very minute quantities, this must be true. But we find no such effects. We are consequently compelled to assume that such do not exist or, at least, have not existed during geological time. In other words, the halo tells us unequivocally of the stability of the elements in general over the whole of geological time—a period certainly not less than some one hundred million years.

In recent years it has been found possible to make considerable advance in the study of haloes. A lucky find of very fine thorium haloes has rendered possible a careful analysis of the successive stages in the development of these objects. Similar information may be obtained from the beautiful uranium haloes of Ballyellen, County Carlow, Ireland.

It is obvious that the halo must be regarded as the resultant of the superimposed activity of eight rays in the case of

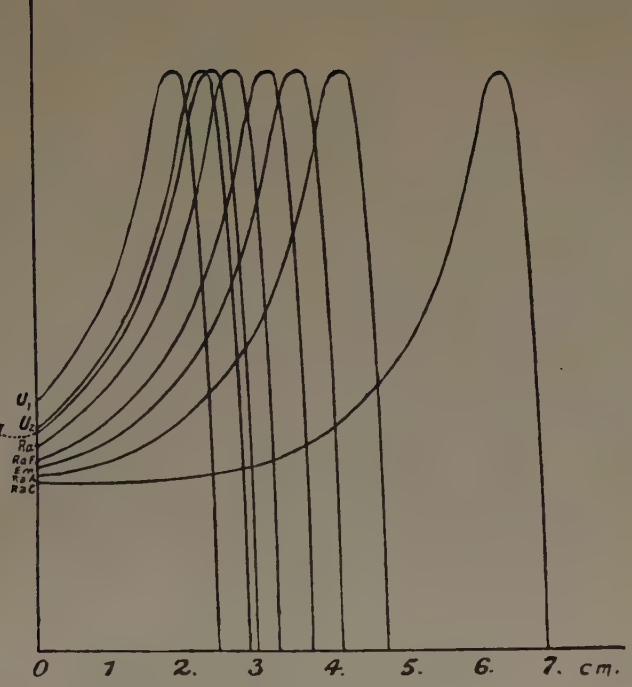


Fig. 9. The eight Ionisation Curves forming the Uranium Halo

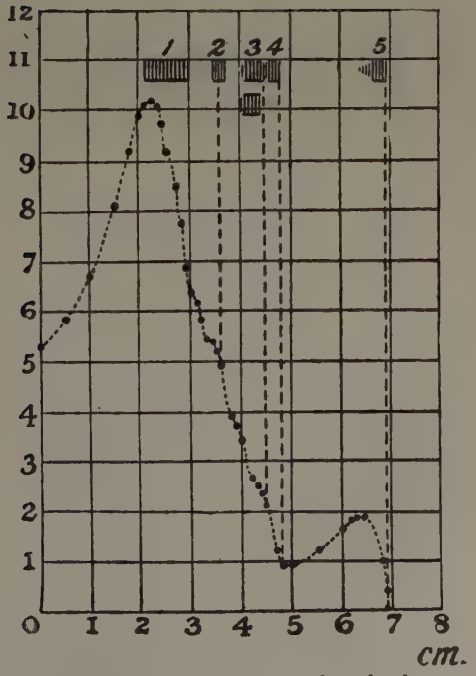


Fig. 10. Integral Curve of Ionisation for Uranium Halo

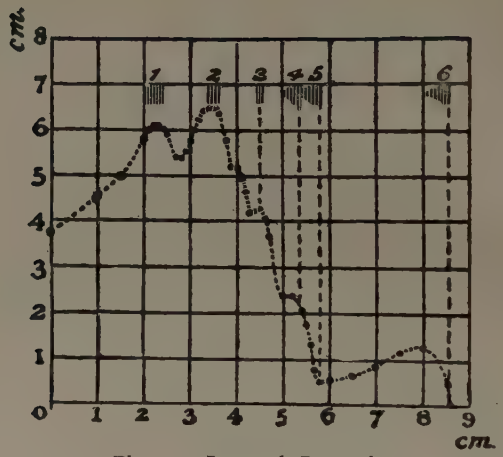


Fig. 11. Integral Curve for Thorium Halo

uranium haloes and of seven rays in the case of thorium haloes. We may plot the effects of these several rays, ascribing to each ray a distribution of ionisation as given by the Bragg curve. Figure 9 shows this first step. The second step is to add the vertical ordinates of all the curves at sufficiently close intervals. When this is done and when allowance is made for the spherical divergence of the rays we get a resultant curve of ionisation as shown in the next figure. (Figure 10.) Now this is for the uranium halo. In the thorium halo a like procedure yields a somewhat different integral curve of ionisation. (Figure 11.)

Let us now compare these curves with the carefully measured drawings of haloes as shown on plate facing next page. The several features of these drawings are transferred to the integral ionisation curves of uranium and thorium. We do this by marking above these curves the positions of the several observed rings, scaling accurately the radius of the ring from the axis of X as starting-point.

We see, when we study these drawings, that the halo in point of fact reproduces accurately in its several rings the crests and hollows of the ionisation curves. The fit is perfect throughout within the attainable limits of measurement in the case of the thorium halo. In the case of the uranium halo the inner rings of the halo do not quite so perfectly fit the integral of the curve of ionisation. There is a slight misfit in the case of the first or innermost ring more especially. This is the ring primarily due to uranium itself upon its first break up.

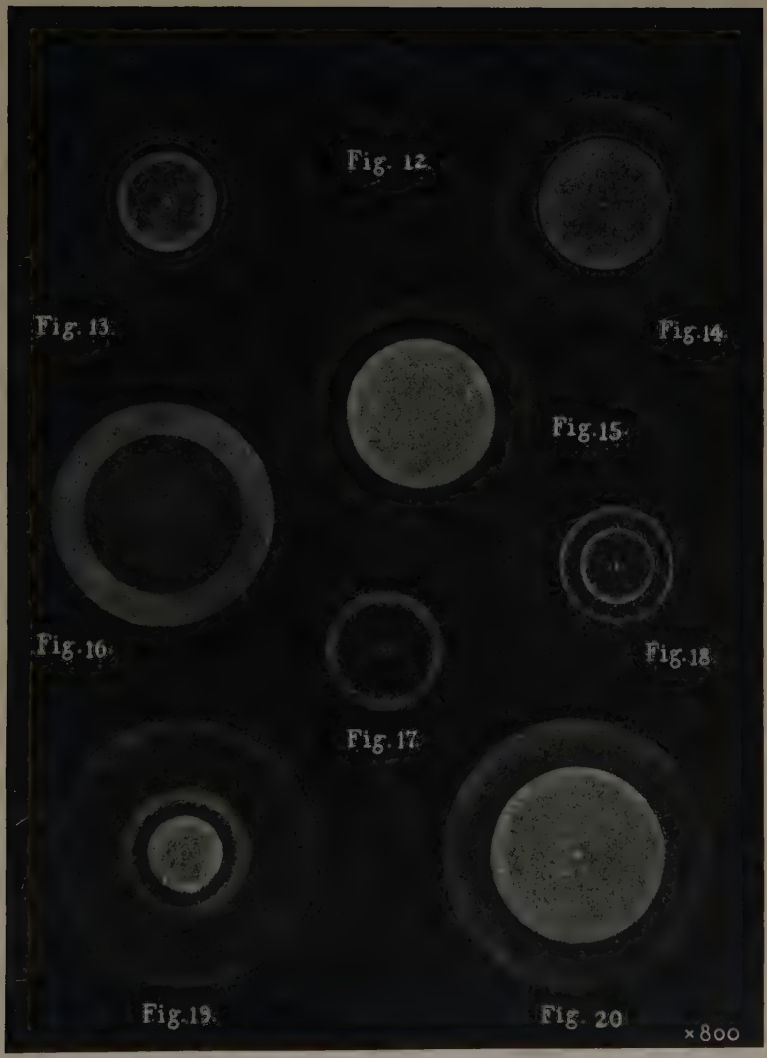
This may appear a trivial discrepancy at first sight. But, in point of fact, a very important question *may be* involved. We shall endeavour to state the matter very briefly, for it is too soon to regard it as more than suggestive. Some other explanation may yet be found.

It is known as an empirical statement that the range of

the alpha ray is connected with duration of life of the element giving rise to it. It is found that short-lived radioactive elements give rise to rays of long range, whereas those of long life give rise to rays of short range. The period of average life of uranium 1 is very long—some 6×10^9 years. Its alpha ray is the least penetrating of all, and along with the ray of U_2 is accountable mainly for the inner halo ring. But we find the halo ring a little too great in radius. Can it be that this indicates a more rapid break up of uranium in the remote past? This explanation must not be set aside too hastily. It is possible that originally the atoms of uranium were not exactly as they are now. We have got more catholic in our ideas of atomic properties in recent time. Atoms may possess identical chemical and physical properties and may differ a little in atomic weight and in radioactive behaviour. If there were originally—that is, attending the original genesis of uranium, however that may have been brought about—uranium atoms of varying radioactive properties, some decaying faster than others, the faster decaying atoms might long ago have been exhausted, the wider halo-ring recording their former existence.

There is a reason, coming from quite another source, for supposing a former more rapid radioactive transformation of uranium. This source, strange to say, is connected with calculations respecting the age of the earth.

Geologists have calculated the age of the earth by various methods, all involving the *rate* of denudation as now observed. We have the rate of accumulation of sodium salt in the ocean as compared with the existing quantity of sodium in the ocean; the rate at which sediments are being laid down as compared with the quantities of sediments accumulated over geological time. All such methods afford time periods, since the beginning of denudation, of the order



Figs. 12, 13, 14, and 15, Stages in Formation and Development of Uranium Haloes.

Figs. 18, 19, and 20, Stages in Formation and Development of Thorium Haloes.

of one hundred millions of years. Solar theory shows that the present supply of solar heat is difficult to account for even over this period.

But we may calculate the age on radioactive theory and measurement. Uranium finally breaks down into lead. If we measure the quantity of lead in a particular mineral—one formed, say, in Cambrian times—and assume that the rate of break up of uranium was all along what it now is, we are driven to assume that it would have taken some twelve hundred millions of years for the lead to have accumulated. If, however, we make the same calculation respecting thorium, which also seems to end up in lead, we find that the age of the earth is fairly correctly given by geological time. True, attempts have been made to account for the contradictory evidence of the radioactive method by assuming that thorium lead is not all stable, that a part of it turns into something else. What that something else is has, however, not hitherto been found.

In this difficulty the evidence of the halo is not without interest. You see, it throws the error upon uranium and leaves thorium as correctly supporting geological methods of finding the age. For it suggests that we cannot use uranium-derived lead as an indicator of geological time, for in fact we do not know the rate at which it has been produced. The final word on this matter has still to be said.

JOHN JOLY.

VI

BIRTH AND GROWTH OF CRYSTALS

WHEN I was asked by the Rice Institute to deliver a lecture during a visit of the British Educational Mission to America it was with great diffidence that I accepted the invitation, not only because there was little opportunity of writing anything worthy of the occasion during a somewhat strenuous journey, but because I have for the last ten years been entirely engaged upon university administration, a subject which would hardly be suitable for such a lecture.

I feel that I should like to address the Institute upon the subject of my own scientific work, but, for the reason which I have mentioned, that work came to an end ten years ago and I have neither had time nor opportunity to keep in touch with more recent advances in scientific research in the subjects which interested me. Anything that I can say is therefore necessarily out of date. It may, however, be worth while to give a brief sketch of the experiments conducted in my laboratory while I was professor at Oxford, up to the year 1908, in the hope that others may be encouraged to continue research in what always seemed to me a particularly fascinating subject.

The growth of crystals has always been a matter surrounded with some mystery. The mere fact that crystals, which are in most respects so unlike living things, can yet grow like animals or plants and assume the most beautiful and symmetrical shapes has always invested them with a peculiar interest. Indeed, in respect of this property one is

tempted to regard them as on the borderland between the living and the non-living world. Any one who watches a crystal of any substance, such as alum, sugar, or sal-ammoniac, growing in a solution, must be impressed by the marvellous way in which each crystal behaves as a separate individual and continues to increase in size by absorbing new material from the solution while maintaining the most beautiful regularity of shape. The crystal, whatever it may be, clearly possesses an inherent power of orderly growth. More wonderful still is the power possessed by any crystal which has been taken out of its solution, of continuing to grow when it is again immersed in a strong solution of the same substance weeks or years after it first ceased to grow. It appears at first sight that a crystal is in a sense both living, because it can grow, and immortal, because it never loses the power of growth.

Although the facts are so well known, comparatively little is understood of the exact process by which, during its growth, a crystal attracts to itself liquid particles from the solution by which it is surrounded and builds them up into a perfect solid structure endowed with the peculiar crystalline symmetry, which, although it may resemble that of certain organisms, is in reality of a totally different character and belongs to crystals alone.

Still less is known concerning the birth of a crystal and the manner in which it first emerges from the liquid, or in what guise. It always appeared to me that in order to obtain a fuller understanding of the actual process of growth some attempt should be made to study what is happening at the exact surface of contact between the growing crystal and the liquid by which it is surrounded. I was therefore led, many years ago, to attempt in the first instance to measure the exact strength of the solution where it is in contact with the

growing crystal. No experiments had previously been made with this object, and, indeed, it seemed very difficult to make sure that the determinations should be confined to the ultimate layer of liquid in actual contact with the crystal. By means, however, of special apparatus in which the growing crystal was viewed through the sides of a glass trough containing the solution it was possible to transmit the light from a sodium flame through the transparent crystal and to measure the angle of total internal reflection on a crystal face inside the crystal, and so to find the refractive index of the liquid in actual contact with the face and finally from this to find the exact strength of the liquid.

In order to determine the strength of the solution from this index it was necessary to make a number of measurements of the exact refractive index in solutions of different known strength and at different temperatures; and the method by which this was done consisted in using, in place of the crystal, a glass prism immersed in a solution of known strength and measuring by total reflection within the prism the refractive index of the cooling liquid in contact with it. For this purpose, and in order to obtain a uniform solution, the liquid was kept stirred throughout the experiments by a revolving fan.

In the course of the experiments made before the stirrer was introduced, a very curious fact disclosed itself. It was found that the refractive index of the liquid generally rose to a maximum and then, at a certain temperature and for no apparent reason, became suddenly reduced. When, on the other hand, the solution was kept stirred it was found that a small shower of crystals generally appeared at or about the temperature of saturation, but that after the temperature had fallen further for about ten degrees there came a second and much denser shower of crystals, and that the tempera-

ture at which this occurred was precisely that at which the refractive index suddenly fell in the earlier experiments. The ordinary view about a cooling solution is that a crystal of the dissolved substance immersed in it continues to be dissolved until at a certain temperature it begins to grow again. The liquid is then saturated, and as it cools further and becomes more and more supersaturated the immersed crystal continues to grow more and more rapidly. My experiments indicated that as a solution is cooled it first passes into a stage in which it is just saturated, but at a lower temperature it passes abruptly into a second stage in which there is suddenly increased crystallization of quite a different sort in the supersaturated solution.

The change of refractive index in the earlier experiments was evidently due to the same cause; but the increased crystallization was only made visible by the thick cloud of crystals produced in the later experiments through stirring. The fact that any solution may be cooled far below its saturation point without crystallization taking place, and that when it becomes sufficiently supersaturated it may be made to crystallize suddenly either by dropping a crystal into the solution or by shaking it, is one which has long been familiar to students of the subject. The well-known words in "In Memoriam,"

> "Break, thou deep vase of chilling tears
> That grief hath shaken into frost,"

refer to this effect; but there had not, so far as I am aware, been any previous observations which indicated that a sudden change takes place at a definite temperature in the crystallizing power of a supercooled solution. Ostwald had, some years previously, sought unsuccessfully for such evidence.

There was another very interesting feature of my experiments. In dealing with a given solution it frequently happened that on the first day the earlier thin shower of crystals did not appear, but in later experiments with the same solution on the following day the thin shower always made its appearance at the temperature of saturation, accompanied of course by a slight diminution in the refractive index, and the dense shower always occurring later at a perfectly definite temperature accompanied by a very large diminution of the refractive index.

I think the explanation of this is to be found in the fact that in the first experiment the liquid cools without any inoculation from the dust of the air, but that in the later experiment, when minute and invisible particles of the dissolved substance have got into the air of the laboratory, it is impossible to prevent such particles from falling into the solution and acting as centres of crystallization as soon as the temperature has fallen to the saturation point. The growth round such centres is naturally very slow, since the liquid is only slightly supersaturated, and this gives rise to the first thin shower; but there was no doubt at all that at a lower temperature a totally different and much denser shower made its appearance from some other cause. If this be so, the question was naturally raised whether the first shower could not be entirely obviated by enclosing the solution in a sealed glass tube. A number of experiments were therefore made by Miss Isaac and myself in which aqueous solutions of different substances and different strengths were enclosed in sealed glass tubes and violently shaken as they cooled.

We invariably found that no crystals appeared in the solution until a definite temperature was reached, the liquid then being strongly supersaturated, and this temperature was identical with that at which the denser cloud of crystals ap-

peared in the same solution when it was stirred in the open glass trough. We entirely failed to produce any crystallization at a higher temperature. For example: a 48.2% solution of sodium nitrate is saturated at twenty-six degrees. Below this temperature a crystal of sodium nitrate introduced into the solution will continue to grow. Above this temperature a crystal will begin to dissolve. Such a solution, when stirred in an open trough, generally produces a thin floating shower of crystals at twenty-six degrees, and when it cools to sixteen degrees will suddenly yield quite a dense shower of crystals. Enclosed in a sealed tube, and continuously shaken, the same solution will only begin to crystallize at sixteen degrees, when, as might be expected in such a strong supersaturated solution, a dense cloud of crystals makes its appearance. If a 51% solution of sodium nitrate is saturated at thirty-nine degrees it only yields a dense shower, both in the open trough and in the sealed tube, at a temperature of thirty degrees.

The final conclusion therefore is that a 48.2% solution of sodium nitrate only begins to give birth to a few crystals at twenty-six degrees in an open vessel because the liquid is inoculated by crystal germs falling into it from the air; but at sixteen degrees an enormous number of fresh crystals appear quite independently and, to all appearance, spontaneously. At twenty-six degrees the liquid, as it cools, passes from the unsaturated to the supersaturated condition in which crystals can grow provided they are introduced into the solution from without; but at sixteen degrees the liquid, as it cools, passes into a new condition in which crystals can be produced by mechanical means, such as violent shaking. Between twenty-six degrees and sixteen degrees the solution is in what we call the metastable condition; below sixteen degrees it is in what we call the labile condition. The two

showers may be distinguished by the same names, the first thin shower being the metastable one and the second dense shower being the labile one. Inoculation with the minutest invisible germ is sufficient to start crystallization around the germ at any temperature below that of saturation, but inoculation of a liquid which is in the labile state produces a violent growth of needle-shaped crystals and, if it is shaken, a very dense cloud of crystals.

By conducting a large number of experiments on many cooling solutions at different temperatures we were able to map out, in addition to the curve of solubility, which gives the relation between the strength of the solution and the temperature at which it is saturated, a new curve which we called the supersolubility curve, giving the relation between the strength of the solution and the temperature of this spontaneous crystallization. (Figure 1, Goniometer.)

The diagram, Figure 2, shows the solubility curve S and the supersolubility curve T in a cooling solution, in which the temperature is indicated by the ordinate and the concentration by the abscissa. As a solution of which the concentration is X is allowed to cool it becomes saturated at the temperature a; and if it is allowed to cool further without any inoculation no crystals will appear until the temperature b is reached, when the liquid becomes labile. Crystals can then be generated by shaking or by other mechanical means, and the strength of the solution is reduced with a slight rise of temperature until at f it again reaches equilibrium, when it becomes saturated. Of course, a solution which is kept perfectly still may be cooled to a much lower temperature without any crystals appearing.

A very simple method by which the passage from the metastable to the labile condition may be made visible is to scratch the surface of the containing vessel by a rod immersed

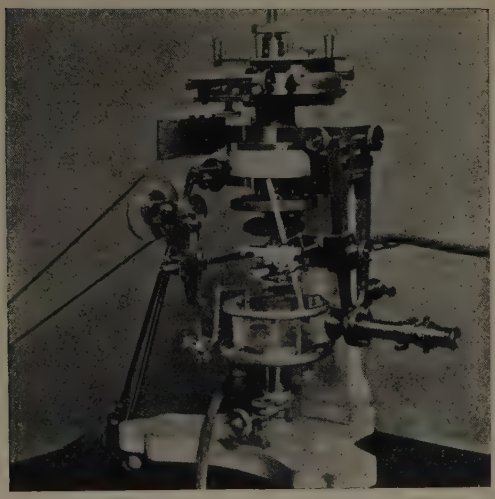


Fig. 1. Goniometer

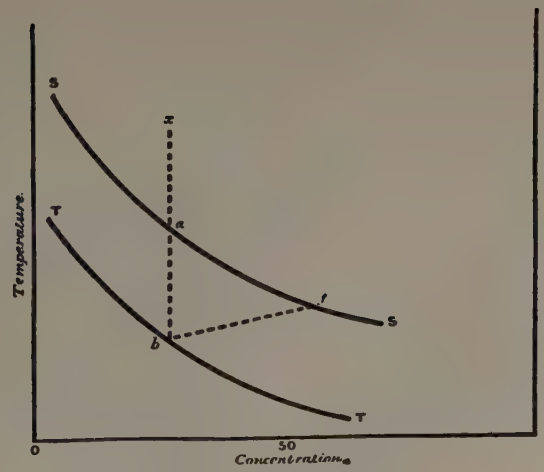


Fig. 2

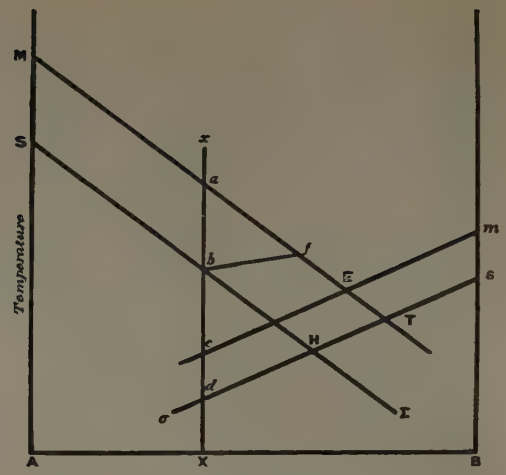

M
S
Temperature
x
a
b
c
d
σ
f
E
H
T
Σ
m
s
A
X
B

Fig. 3

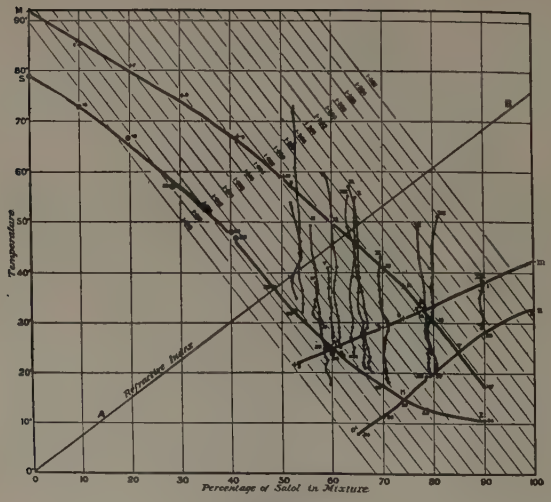

Temperature
Refractive Index
Percentage of Salol in Mixture
0
10
20
30
40
50
60
70
80
90
100

Fig. 4

in the solution, when it will be found that no crystals appear on the line of scratch until the labile condition is reached. This is the old-school experiment in which the inside of a test tube is scratched with a glass rod in order to show that crystallization takes place along the line of scratching. It used to be interpreted as evidence that crystals form along a line of scratch by reason of its sharp edges. If this were true, they should, of course, form on an old and not only on a new scratch. In the experiment as commonly performed no precaution is taken to prevent inoculation, and when the rod is introduced it is probably contaminated by crystalline particles and thus produces a line of crystals even in a metastable solution.

We succeeded in tracing the solubility and supersolubility curves for a large number of substances dissolved in water. Clearly, similar solubility curves would be obtained for the freezing of ice from such solutions at appropriate temperatures. We therefore conducted a number of experiments on the crystallizing temperatures of each of two substances dissolved in each other, and diagram No. 3 shows in a general form the results of such experiments.

ME is the solubility curve of the substance A, and mE the solubility curve of substance B, meeting in the eutectic E; M and m being the melting-points of the two substances. SH and sH are the supersolubility curves for the two substances, meeting in what we call the hypertectic point H. Between the curves ME and SH the substance A can crystallize only by inoculation, and below the line SH it can crystallize spontaneously. Below the curve mE the substance B can crystallize only by inoculation, and below the curve sH it can crystallize spontaneously. If a solution of composition X is cooled it becomes saturated with regard to A at the temperature a, labile with regard to A at the temperature b,

and at this point A will crystallize if the mixture be shaken. If, however, it is kept perfectly still and cooled to the temperature c, the other substance B can then be made to crystallize by inoculation with B; or, if it is kept still further unshaken, it may be taken down to the temperature d, at which shaking may produce spontaneous crystallization of B. We have made a number of experiments on mixtures of this sort, —for example, one of salol and betol,—and have traced for them the complete curves approximating to those shown in Figure 4.

In all these experiments the process was conducted in two ways: the changes in each cooling solution were traced by changes in the refractive index, and the points which determine the supersolubility curve were determined not only by the sudden change in the refractive index, but by the cloud which appears when the mixture is shaken in a sealed tube. It will be found, I believe, that the same general principles hold for mixtures of more than two components, and we traced supersolubility curves, for example, in mixed aqueous solutions, such as sodium nitrate and lead nitrate, in which three components are concerned.

I may allude to an even more complicated variety of these experiments in which one of the crystallizing substances is capable of crystallizing at different temperatures in three different modifications. A long series of experiments made upon mixtures of mono-chlor-acetic acid and naphthaline enabled us to trace the solubility curve and the supersolubility curve for naphthaline, and no less than three distinct solubility curves and supersolubility curves for the mono-chlor-acetic acid, which were found to exist in three different modifications possessing three distinct melting-points. The result of these experiments is shown in Figure 5.

Now, I believe that whenever crystallization, whether of

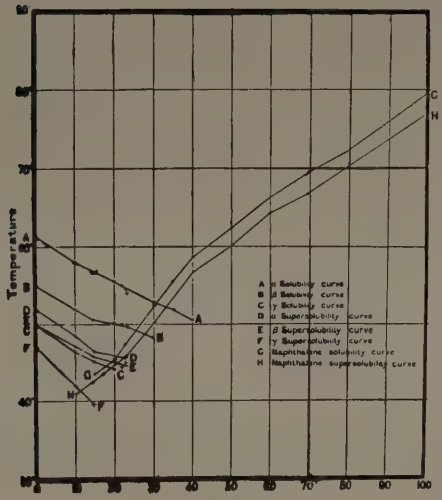

Temperature
A
B
C
D
E
F
G
H
A α Solubility curve
B β Solubility curve
C γ Solubility curve
D α Supersolubility curve
E β Supersolubility curve
F γ Supersolubility curve
G Naphthalene solubility curve
H Naphthalene supersolubility curve

Fig. 5

single substances or of mixtures, takes place, these general principles are to be traced. In ordinary experiments the cooling liquids are not preserved from inoculation, and crystalline fragments or germs probably start the process of crystallization in the metastable state. But when the liquid becomes further cooled until it reaches the labile state, there is always a sudden and rapidly increased rate of growth, resulting in either the production of a cloud of new crystals, generally needles, or of a largely increased rate in the growth of a single crystal. My own belief is that whenever a solution crystallizes in needles, this is due to the fact that it is growing in a labile solution. Each crystal is surrounded by a sheath of metastable solution which prevents it from growing rapidly at the sides, but is advancing at its extremity into the surrounding labile solution so that it grows with great rapidity and shoots out in the form of a needle. Chemists have always been apt to describe various substances as crystallizing in plates or pyramids, prisms or needles; whereas these shapes depend merely upon the conditions of growth. Any one who watches a drop of potassium bichromate crystallizing on a warm slide of glass can trace the whole process. The ring of crystals which first form on the edge of the drop by inoculation, or perhaps by sudden cooling, advance quite rapidly as a forest of needles; but when, owing to the crystallization, the strength of the solution is reduced to the metastable state, each needle suddenly begins to thicken and extend itself into a plate or prism, and continues to grow quite slowly; as other parts of the drop cool, spontaneous crystallization may suddenly appear at one point or another, either through inoculation from a germ in the air or else by sufficient cooling which reduces the solution at that point to the labile state and makes it burst into a rapid growth of

needles. After a few seconds the slower metastable growth again sets in.

Examples of these two stages will be found by any one who seeks them in almost any process of crystallization. I pointed out many years ago that the porphyritic structure of rocks may possibly indicate that they have solidified in the labile state in a highly supersaturated mixture; and evidence of similar changes is to be found in the cooling of alloys or metallic mixtures. I believe that in some cases where experiments of this sort have been repeated by other observers, the question has been raised whether it is really impossible to induce crystals to grow by mechanical means above the labile temperature, and whether inoculation is necessary. It has, I believe, been suggested that the exact temperature at which mechanical means can produce crystals depends upon the violence of the stirring or mechanical agitation which is employed; but whether this be so or not, my own experiments have led me to believe that the supersolubility curve can be quite definitely plotted, and that it indicates, at any rate, a real physical change in the cooling solution, for when crystals are already growing in it they suddenly begin to grow with greater rapidity at this stage, whether other crystals make their appearance or not at precisely this temperature.

Let me now call attention to another very interesting experiment—one which relates to the birth rather than the growth of crystals. It is known that when two substances have nearly the same form and crystalline structure one can grow upon the other in a parallel position, so that the second crystal forms a continuation of the first. One sort of alum immersed in a solution of another sort of alum continues to grow just as though it were in a solution of its own sort. Again, sodium nitrate possesses very nearly the same form as the mineral calcite, and if a drop of solution of sodium

nitrate be placed on a clean surface of calcite it at once deposits small crystals which are parallel to one another and to the crystal on which they are growing. In other words, two crystals which bear this relation to each other behave almost in the same way as two crystals of the same substance.

A number of experiments made at my suggestion by Mr. Barker in my laboratory at Oxford indicated that among all the carbonates which have nearly the same form as calcite, none possesses this power except calcite itself. Now calcite happens to be the only one which has a molecular volume nearly equal to that of sodium nitrate. This seems to me to show that if one substance possesses the power of making the other grow upon it in parallel position, it must be nearly identical with the other, not only in the arrangement of the particles (which determines the shape), but also in the distance between those particles (which determines the molecular volume). This was found by Mr. Barker to be true for a large number of different substances. Figure 6 represents two structures having the same cubic form but a different spacing so that they have not the same molecular volume. If the meshes of the structure were not only of the same shape but of the same size, they would have the same molecular volume and would fit together, and this would be a reason for their growing together in parallel position.

Now, so far as my observations go, I have reason to believe that a substance which can make another grow upon itself in this remarkable manner is also capable of starting crystalline growth in a supersaturated solution of the other. It certainly appears to be true that a crystal of calcite dropped into a solution (even a metastable one) of sodium nitrate at once starts the growth of crystals, whereas the other minerals belonging to the calcite group do not possess this power.

A great many experiments on this question are needed,

and I am in hopes that some student will be encouraged to pursue the subject further. The experiments are easily made, and the result is very wonderful. The mere parallel growth of one crystal upon another we may well imagine to be due to one possessing a structure very nearly identical with the other, so that they fit into each other. This is merely a geometrical relation.

But that a crystal of one substance should excite crystallization in another in a solution in which it is itself insoluble is a surprising fact and must be due to something more than a mere fitting together of two structures. It compels us to ask ourselves what is the process by which the solid crystal draws to itself the particles from the liquid. It forces us to think of the movements of these particles rather than of their mere arrangement. The study of crystals has been mainly confined to the physical properties of the solid structure, and has tended to ignore the processes of its birth and growth. Every point inside a crystal has at one time been a point in its surface, and the history of its deposition is a borderland problem to be investigated by a study of the conditions prevailing when the solid crystal was in contact with the solidifying solution.

I have often thought that the particles in the liquid solution may be moving in a quite irregular way, whereas those in the solid crystal may be endued with a rhythmic motion, and that one may have the power of responding to the other just as one violin string responds to another, provided that the two possess kindred structures which are very much alike. If this be so, both the structure and the power of evoking crystal growth are the result of the regular pulsations or movements belonging to the particles of the solid. Surely it would be interesting to get more experimental evidence bearing on this question.

Now, if I may pass to a totally different subject, and one which is more closely related to my occupations of the last ten years since I relinquished the study of minerals and crystals and exchanged research for university administration, I should like to say a few words about university education.

At the risk of appearing fantastic, I will venture to state my views on this subject in the form of an analogy based on the behaviour of supersaturated solutions. As a result of my experiments I have generally found that the best way to obtain a very perfect crystal of any substance is to take a solution in the metastable state; that is to say, not so strongly saturated as to crystallize spontaneously, but only just supersaturated. Introduce into it a germ in the shape of a small crystal or fragment. This will then continue to grow not too rapidly and with perfect regularity if the conditions are not altered. If the solution is too strongly saturated the growth may be too rapid, and if it passes into the labile condition the growth will be so turbulent that a mass of ill-formed crystals or needles will be produced.

It has often seemed to me that the human mind passes into a stage which may be compared with supersaturation—a stage in which it suddenly becomes ripe for a new and rapid growth. During the early period of childhood the mind is quick to receive and to assimilate, and naturally follows the mind of the teacher; but as it becomes more fully charged with material for reflection there comes a stage at which the young mind should be encouraged to act for itself upon the material which has been and is being assimilated. Attempts to encourage this independent activity at too early a stage will probably be doomed to failure, just as an attempt to make an unsaturated solution crystallize will fail. But when the new stage is reached the mind will natu-

rally respond to any encouragement and the student will begin spontaneously to form his own ideas. If, on the other hand, this encouragement be not given, the natural tendency to spontaneous activity will be checked, but will always be striving to assert itself, until it bursts out in a turbulent activity which may be compared with the turbulent and irregular crystallization of the labile solution.

The right way to encourage the regular and orderly growth of a healthy and active mind is to begin as soon as the proper stage is reached and encourage it to grow from its own resources, just as the proper way to obtain a perfect and well developed crystal is to introduce the germ as soon as the supersaturated state is reached.

Let me even pursue my fanciful analogy a little further. There are two ways in which the mind of the young university student, fresh from school and saturated with teaching, may be stimulated to a healthy and steady growth. Just as the ripe solution may be made to crystallize by dropping into it either a speck of the dissolved substance or a speck of another crystal closely allied to it, so may the mind be stimulated to independent thought by the influence of a fellow student of kindred tastes, or by the influence of some other person, perhaps a teacher, perhaps an author encountered through his writings, but in either case some one who, through kinship of spirit, stirs the enthusiasm of the young student and kindles in him that latent spark of original thought which is possessed by all, but which may remain dormant too long unless kindled early in the university career. Almost every one can recollect some written or spoken word, some inspiring idea, which first set him thinking on his own account. The suggestion may come from a congenial spirit among his fellow students: this, indeed, is one of the immense advantages of a well-developed student

life, with its social and intellectual activities and its fruitful friendships. The isolated student loses one of the most powerful incentives to activity of thought when he is separated from the intellectual intercourse fostered by college societies and college friendships. Sometimes the incentive will come from a sympathetic teacher. Many are the instances in the biographies of great men who attribute the direction taken by their life work to the early prompting of a stimulating teacher.

Now the object of my analogy is to make clear that, in my opinion, this passage from the assimilative to the reflective stage should, as far as possible, coincide with the passage from school to the university or to the college. I do not believe in the overlapping of school and college work; even if the same subjects are taught at approximately the same standard during the last year of school life and the first year of university life, the method should, I think, be entirely different. If a boy's mind is ripe for the independent thought which properly belongs to the college, he should be at the college and not at school. If it is not ripe he should be at school. When a boy has passed from school to college, he should find himself in a totally different environment and his intellectual growth should make an entirely new start.

Why should not the attitude of mind in university work be entirely different from that which prevails at school? Why should not teacher and student be from the outset working together in the spirit of adventure; ready to criticize, and if necessary discard, the old postulates; inspired by the feeling that they are trembling on the brink of a discovery, that the commonest events or the most familiar views can be regarded as open to a new method of approach? I know that this is always possible in science, and

I believe that in the hands of a teacher who is himself helping to make new knowledge it is possible in any subject.

When a student at the college or university is condemned to pursue his work as a task or a discipline on the general lines of school teaching, and with no new inspiration of purpose or of method, then a mind ripe for new growth is being forcibly held back and its real education is checked. If, on the contrary, his interest is so aroused that he is driven to think for himself, real educational progress is being made. It is so true that at this stage education should be encouragement and opportunity for the mind to exercise its natural powers.

Why should a university student ever be set to learn facts except with the conscious purpose of using them as means of progress? Why should he ever have the views of his teacher forced upon him unless he is at the same time encouraged to criticize them? Too many a student takes sedulous notes and drinks in the ideas of his professor with the sole object of storing up knowledge for examinations. In this process there is little or no encouragement of that independent thought which should be the very spirit and essence of all university work.

I wish that every professor should make his students in some sense, and in however humble a capacity, collaborators with him in the work on which he is himself engaged; and I would wish him to go out of his way, if necessary, to conduct investigations adapted to the capacity of his students. In this way more than in any other will the interest and, through it, the creative activity of the student be aroused. Many a university student has failed to realize that the value of university work depends almost wholly upon the amount of independent thought and activity put into it by himself.

Though teaching and the best methods of teaching may

be the most important aspects of school education, learning and the best methods of learning should surely be the most important aspects of university education.

To arouse the interest, to stimulate creative activity and to guide it into paths in which it will not be ineffective, are, I believe, the chief functions of the university teacher.

I have been tempted to speak on these matters because it was my endeavour, when a teacher, to interest all my students, even the beginners, from the very outset in the investigations in progress in my department, such as those which I have endeavoured to describe to you. This always seemed to make their own work more inspiring.

My excuse for thus wandering from the main object of my lecture must be my desire to express the hope that the Rice Institute will always maintain that spirit of sympathy and collaboration between professor and student, that spirit of advance and enterprise, of progress and discovery, which should be, I believe, the foundation of all university work, and will enable us to go forward and "greet the Unseen with a cheer."

HENRY A. MIERS.

VII

THE NEWLY DISCOVERED FRAGMENTS OF EPHORUS, AND THEIR BEARING ON THE AUTHORSHIP OF THE *HELLENICA OXYRHYNCHIA* AND ON THE STYLE OF EPHORUS

I THANK you very much for the nice things you have said about Oxford. As I am going to lecture about Oxford to-morrow night, I will not say anything about Oxford this afternoon.

I want to apologize for my subject, because I am afraid that it is highly technical, and I am afraid that most of the time I shall be speaking in Greek. But there is one thing I want to suggest, coming here to an Institute where up to the present, I think, it is the scientific side that has been chiefly developed, and that is this: Evidence must be much the same, the conditions of proof much the same, whether we are dealing with a historical subject or a subject in physics or chemistry. Of course, the subject matter is not the same. The nature of the evidence is not precisely the same. The same degree of proof that would satisfy a mathematician is hardly to be expected from a historian. But for all that, historical investigation which is not scientific is worthless.

Now, to make my subject intelligible, I must begin with some history which is not ancient. Early in the year 1908 a fragment of a Greek historian was published which had been recovered from the rubbish heaps of an Egyptian country town, Oxyrhynchus by name, by two old pupils of mine, who for many years past have been my colleagues, Grenfell

and Hunt. The discovery gave rise to a very animated controversy all over Europe as to the authorship of the fragment. The view which was put forth as the authoritative view by the leading German scholars—because in Germany they are nothing if not authoritative, particularly at Berlin—was the view that this was a fragment of a work of the historian Theopompus, one of the most famous historians of the fourth century B.C. In August, 1908, there was an international historical congress at Berlin, at which about fourteen hundred members were present, and a very large number of these were especially interested in Ancient History. I had contributed an article to a German periodical which deals especially with ancient history,[1] and that number came out just in time to be discussed at the congress. In this article I ventured to call in question this view, so generally held in Germany, that the author of the fragment was the historian Theopompus. Subsequently I gave a course of eight lectures before the University at Oxford upon this subject, and I afterwards published them under the title of "*Hellenica Oxyrhynchia:* its authorship and authority." In these lectures I attempted first of all to disprove the theory which had received the *imprimatur* of such great names as those of Wilamowitz-Möllendorff and Eduard Meyer, that the author was Theopompus, and I endeavored to establish the positive position that it was a fragment of the eighteenth book of the historian Ephorus, the great rival of Theopompus in the fourth century B.C.

Now, when two hypotheses are put forward upon any subject, in the long run the test which decides between them is this: If new evidence turns up, which of the two hypotheses does the new evidence support? Does it support hypothesis A? Or does it support hypothesis B? When

[1] *Klio.*

another fresh piece of evidence turns up, once more the question has to be asked, Does this support A? Or does it support B? And if all the new evidence that turns up goes to support hypothesis B, and not hypothesis A, then it becomes very clear that hypothesis B is the correct hypothesis, and hypothesis A is the wrong hypothesis. Since my lectures were published new evidence has turned up, and my object this afternoon is to try and convince you that this new evidence is practically conclusive in favor of the hypothesis that I ventured to put forward, the hypothesis that the work was the work of Ephorus, and not of the hypothesis that the work was the work of Theopompus.

I cannot, indeed, claim originality for the theory that the *Hellenica Oxyrhynchia* was the work of Ephorus. This was first definitely put forward by the German scholar, Judeich; and, although the arguments that he advanced in favor of it were obviously extremely unconvincing, he deserves great credit for being the first to state quite plainly that he believed Ephorus to be the author.

What does the new evidence consist of? And why do I call it new? It consists of two fragments, or, rather, one fragment in one case, and a number of fragments in another, which have been identified, not only since 1908, but since my lectures were delivered at the end of 1912. The former was edited by Grenfell and Hunt, jointly; the latter set of fragments by Grenfell alone. Hunt, like most of our professors, exchanged the professorial gown for the soldier's uniform, and he has been doing, first, regimental, and afterwards staff work for the last four years.

The first of these fragments was edited and published in Volume XI of the *Oxyrhynchus Papyri,* in 1913. It is but a short fragment, consisting of only 195 words; and I call it new, because it was identified, not only since the discovery

of the original fragment, but since the congress at Berlin, and since the publication of my lectures. As to the other fragment, certainly no one can question its claim to be new, because when I left the shores of England it had not been published, and I am not sure whether it has yet been published;[1] but I have the proof-sheets of it here, and I was in constant communication with Prof. Grenfell while he was editing it. This is a much longer fragment. About one hundred lines of it are intelligible. There are a great number of individual fragments in all, some of them not bigger than a quarter-of-a-dollar piece, but there are sixteen that are intelligible, and can be pieced together.

The earlier of the two fragments in point of publication, that published in 1913, relates to the early history of Sicyon; and the remarkable thing about it is that it fits on precisely to a fragment of Diodorus, one of the excerpts from the Eighth Book (viii, 24). The newly discovered fragment picks up the story just where it breaks off in the excerpt from Diodorus. The story in the excerpt of Diodorus is as follows: An oracle was given to the people of Sicyon to the effect that their city should be subjected to the régime of the lash (μαστιγονομηθήσεσθαι), for a period of one hundred years, and the oracle warned them, when they returned from Delphi to their city, to take notice of the first person to whom it was announced after their landing that he was in the happy position of being the father of a boy. The new fragment fits on exactly to this, and there can be only two possibilities as to its authorship. Either it is a fragment of the *Polity,* or *Constitution, of Sicyon* by Aristotle (we know he wrote such a work), or it is a fragment of the historian Ephorus. There is no third alternative. Against the

[1] It has now been published, with a full introduction and commentary, in Vol. XIII of the *Oxyrhynchus Papyri,* 1919.

theory that it is by Aristotle is the extreme improbability of such an obscure work as this on the *Constitution of Sicyon* being copied out in the second century of our era. On the other hand, Ephorus was one of the most famous writers of antiquity, and if any historian was likely to be copied out it would be he. But there is a much more conclusive argument. It is one of the most certain results of historical criticism that the work of the historian Diodorus Siculus, down, at any rate, to the reign of Philip of Macedon, is based upon, or copied from, the work of the historian Ephorus. Now, the mere fact that the fragment fits on precisely to this passage in Diodorus, which must come from Ephorus, is fairly conclusive evidence that this is a fragment of Ephorus. And further than that, there are striking coincidences between the fragment and the excerpt from Diodorus. In both there is mention of Andreas, the father of a certain *tyrannus*. In both the oracle is given from Delphi. In both the fragment and the excerpt there is an individual who is described as μάγειρος, that is, a butcher, whose business it was to cut up the animal for the sacrifice. Thus the coincidences are as close as they well could be. Demonstrably, it is the same story by the same writer. Therefore, I do not think it admits of reasonable doubt that this fragment is a fragment of Ephorus. I can, indeed, conceive of a critic maintaining that it is not Ephorus, and maintaining that it is from Aristotle's *Constitution of Sicyon*. But if he did maintain this, he would present an extraordinarily weak case. Such a hypothesis is conceivable, but it is barely conceivable. The probabilities are overwhelming on the side of the other hypothesis that we have here a fragment of Ephorus.

Now, for the other and newer fragment. It is far more important, not merely because it is much longer, but for

other reasons that will subsequently appear. What is the evidence that it is by Ephorus? I will anticipate my conclusion and say that I am convinced, if I am convinced of anything, that when this fragment is published there will be no competent scholar in the whole world who will be prepared to deny that it is from the pen of Ephorus. The case for Ephorus is as conclusive as it is possible to make a case. First of all, this fragment, which, like the other fragment, was written about the year 200 A.D., comes from the same site, the town of Oxyrhynchus in Egypt. It relates to the period of something like fifteen years that followed the great Persian war, a period, roughly speaking, between 479 and 464 B.C. The sixteen individual fragments that can be identified fall into three groups. The first of these relates to Themistocles, and contains an appreciation of his character. The second contains an account of the exploits of the Athenian general Cimon, from his taking up the command of the fleet at Byzantium. The third relates to a plot to assassinate Xerxes, King of Persia. The proof that all this comes from Ephorus is threefold. In the first place, there are several statements made in this series of fragments which we know from Plutarch to have been statements made by Ephorus, and statements to some extent peculiar to him. Firstly, Plutarch says that according to Ephorus the name of the commander of the Persian land forces at the battle of the Eurymedon was Pherendates, and in the fragment we have Pherendates given as the name. Secondly, we know from Plutarch that certain Greek historians represented Themistocles, when he took refuge in Persia, as coming to the court of Xerxes. That was an error. Xerxes was dead at the time, and really it was Artaxerxes, the successor of Xerxes, to whom he fled; but Ephorus is mentioned as one of the writers who brought him to Xerxes and not to Arta-

xerxes, and in the fragment it is to Xerxes, not Artaxerxes, that he comes. Thirdly, the number of the Persian fleet was given by Phanodemus as six hundred, but Plutarch says that it was stated by Ephorus to have been three hundred and fifty, which is the number given in the fragment. You have, therefore, in the short space of one hundred lines three statements which we know from external authority to have been made by Ephorus, and to some extent to have been peculiar to him.

The second piece of evidence is this. We know that there were certain of the later writers who had, at first or second hand, derived their information from Ephorus, and there were certain writers who had derived their information, not from Ephorus, but from other writers. Two of the most important writers who derived their information ultimately from Ephorus were the Roman historian Justin and the Greek writer Polyænus, who composed a work on the stratagems employed by generals in warfare. Now, there is one passage in this papyrus fragment which we can trace in Justin.[1] There is another which we can trace in Polyænus.[2] That is exactly what we should expect, if the fragment is from Ephorus. The papyrus, on the other hand, shows no agreement, no coincidences, with other writers, such as Plutarch,[3] who did not use Ephorus. That is the second piece of evidence.

The third, and the most conclusive, piece of evidence is the correspondence between the papyrus and Diodorus. That is the center of gravity of the whole question. It has

[1] Justin, iii, 1. Xerxes . . . quippe Artabanus præfectus eius in spem regni adductus=Fr. 15. *αυτος κατασχειν την βασιλειαν βουλομενος.*

[2] Polyænus, l, 34, 1. *καὶ πολλὰ σκάφη βαρβαρικὰ ἑλῶν*=Fr. 9, 10. *πολλας μεν . . . βαρβαρικον νεῶν διέφθειρεν.* Fr. 12, 13. *προς τας ναυς εφευγον υπολαμβανοντες αυτοις ειναι φιλιας*=Poly. *τὸν στόλον ὡς φίλιον ὑποδέχονται.*

[3] Though Plutarch refers to statements made by Ephorus, he does not follow him as one of his authorities.

long been a matter of certainty that Diodorus, who was a writer of the reign of Augustus, derived his history from Ephorus, but hitherto we did not know the precise method that he employed; in what manner he excerpted Ephorus; how much he took from him, and how much he left out; nor did we know to what extent the style of Ephorus survives in Diodorus; *i.e.*, how far Diodorus followed the actual language of Ephorus, as well as his statements. For the first time we are in a position to answer these two all-important questions.

I have already pointed out that the first of our two fragments begins exactly where Diodorus leaves off. For this very reason we cannot compare it with Diodorus, because the part of the fragment which we should compare with the excerpt from Diodorus is lost. But the longer fragment, the one most recently discovered, most fortunately covers the ground which is covered by Diodorus, and comparison is therefore possible—comparison both of the subject matter and of the style. I shall presently go in more detail into the question of style. For the moment it may suffice to say that the correspondence in point of style is so remarkable—again and again there are whole sentences in Diodorus which are identical with sentences in the papyrus, or identical except for the alteration of a word or two—that no one in his senses could question that what we have here is the writer whom Diodorus excerpted. Therefore I have ventured to call both of them new fragments of Ephorus.

Now, if those are new fragments of Ephorus, the question at once arises, what light do they throw upon the problem raised in the controversy about the authorship of the *Hellenica Oxyrhynchia?* Do they tend to support the view that Ephorus was the author of that work, or do they tend to disprove it? There are three questions to be considered

here. At the start, when I set out to prove the hypothesis that the *Hellenica Oxyrhynchia* was the work of Ephorus, I found myself confronted with two assumptions that had hitherto been generally accepted. The first was that the scale of the *Hellenica Oxyrhynchia* was far too elaborate, the treatment of the subject far too detailed, for it to be part of a universal history, a history from the beginning of Greek history down to the historian's own days, such as was the history of Ephorus. It was argued that that at once ruled the claims of Ephorus out of court, because the treatment of the subject in the *Hellenica Oxyrhynchia* is a detailed treatment which, it was argued, you could not expect to find in a universal history. The second assumption, which was based on a passage in Diodorus,[1] was that Ephorus in his treatment of history treated it κατὰ γένος. He took a subject—we will say, the exploits of Cimon—and he treated it as a whole, and when he had finished it he went on to a new subject. That is to say, he did not write, to use the technical term, synchronistically. In my lectures I endeavored to disprove both those assumptions. I endeavored to prove, firstly, that the scale of Ephorus was far more elaborate than had been supposed, and, secondly, that as far as the history of the fourth century, the period dealt with in the *Hellenica Oxyrhynchia,* is concerned, his method there was not κατὰ γένος, but synchronistic.

What light, then, do these two fragments shed upon these two questions? First, as to the question of scale. Here the first fragment is important, because it shows conclusively that Ephorus treated this incident, this period of Greek history, the rise of the *tyrannis,* not concisely, but fully. The treatment is very full. More than that, it is entirely independent of our main authority for early Greek history,

[1] Diod., v, 1.

Herodotus. It was already known that Ephorus had a great deal of material for the earlier Greek history which was not to be found in Herodotus; it is now clear that he made full use of it. The fragment, so far as it goes, tends to confirm the contention that the scale on which Ephorus wrote was not what had been assumed; that his treatment was not concise, but full.

Still more clearly does this conclusion follow from the second fragment, because if we compare that fragment with the corresponding passages in Diodorus, we find that while Diodorus sometimes followed Ephorus very closely, he at other times omitted whole subjects which were treated of by Ephorus. We have two or three conclusive proofs of this in this papyrus. One of the incidents referred to is the capture of the island of Scyros. Diodorus dismisses that in about five words, but it is clear from one of the fragments that Ephorus in dealing with this incident dealt with it at some length. The story of the recovery of the bones of Theseus from the island is to be found at length in Plutarch's *Life of Cimon*. It is quite clear from one of these fragments that that story was included in Ephorus. Thus a whole passage of considerable length in Ephorus has been omitted in Diodorus. Similarly, the first fragment, relating to Themistocles, is omitted in Diodorus, there being nothing at all corresponding to it in his narrative. Again, there are in the smaller fragments indications of passages that do not correspond to anything that may be found in Diodorus. They were passages in Ephorus which were simply omitted by Diodorus. It is, therefore, perfectly clear that Ephorus treated that period of Greek history far more fully than Diodorus did; that his scale was far more elaborate than that of Diodorus. The combined evidence of the two new fragments on this question of scale goes a long way to con-

firm and establish what I maintained in my lectures as to the scale of Ephorus' work.

We come next to the treatment of the subject matter. In my lectures I had maintained, as against Judeich, the view of most scholars, that for this particular period of Greek history, the period between the Persian and the Peloponnesian wars, *i.e.*, the period covered in part by the fragment, Diodorus was perfectly correct in his statement that the method of Ephorus was κατὰ γένος; in other words, that his method was not synchronistic. The correctness of this view has been proved up to the hilt by the papyrus. Exactly what had been anticipated is found there. The proof could not conceivably be more complete; and that, I think, indicates that the method of proof was a sound method, because the result arrived at is verified by the papyrus.

But I also endeavored to prove, as against the view of almost all scholars, that the method of Ephorus for the next century of Greek history, the fourth century, the period covered in part by the *Hellenica Oxyrhynchia,* was synchronistic. My method was in both cases precisely the same, because in both cases I based my contention upon an examination of the narrative of Diodorus. From an examination of his narrative of the earlier period I endeavored to prove that the method of Ephorus was κατὰ γένος. From an examination of Diodorus' history for the period of the fourth century I endeavored to prove that the method of Ephorus for that period was synchronistic. What I venture to maintain is this: that if my method was unsound for the fourth century, it would have been unsound for the fifth. It has been proved to be sound for the fifth; and if it has been proved to be sound for the fifth, I venture to contend that it is sound for the fourth. But if the conclusion I had arrived at, that the method of Ephorus in dealing with the fourth century was

not κατὰ γένος but synchronistic, is true, the main argument against the attribution of the authorship of the *Hellenica Oxyrhynchia* to Ephorus disappears.

Now let us come to the third point, the question of style. In dealing with the claim of Ephorus to be regarded as the author of the *Hellenica Oxyrhynchia,* the positive evidence consisted very largely, though not entirely, of the argument from style. The style of the *Hellenica Oxyrhynchia* corresponded to all that the ancients told us about the style of Ephorus. It was diffuse; it was tame; it was dull. But while we knew in general terms that these were the characteristics of the style of Ephorus, we knew at first hand practically nothing about the style of Ephorus, because hardly a single one of the fragments had come down to us in his own words. There were but one or two, and these were too short for any argument to be based upon them. Nor were we at that time in a position to assert that we could discover the style of Ephorus from the language of Diodorus. We are now in a position to make this assertion, and consequently the whole case is altered. We now can argue with confidence from the style of Diodorus to the style of the *Hellenica Oxyrhynchia.* We can say when we discover a coincidence between the style of Diodorus and that of the *Hellenica Oxyrhynchia,* that it is a coincidence not merely between Diodorus and the *Hellenica Oxyrhynchia,* but between the latter and Ephorus. I hope by the time the lecture is over to convince you that the evidence on that head is conclusive.

Let us turn, then, first of all, to the question of the style of the first papyrus, the papyrus about Sicyon. As that consists of only 195 words, we must not expect too much. I do not think that any of you will expect that we shall be able to prove a conclusive case with regard to style on a basis of 195 words; but the surprising thing is, not that we can prove so

little, but that we can prove so much. We can prove a great deal. If we turn to that fragment of only 195 words in length, we can discover at once certain peculiarities in the style of the author of that fragment. The first is his fondness for the genitive absolute. Of course, that is a very common construction in Greek, but he actually manages to use it six times in 195 words. When we turn to the *Hellenica Oxyrhynchia,* we find that there is nothing more characteristic of its style than the frequency of the genitive absolute. The two fragments have so much in common, at any rate.

Another peculiarity in the style of this fragment is the repetition of the article after the substantive, of which we will take some examples. Instead of saying ὁ τῶν Σικυωνίων δῆμος, the writer says ὁ δῆμος ὁ τῶν Σικυωνίων. Of course, that is very common construction, but its frequency in the fragment is remarkable. There are no less than five instances of it in this fragment relating to Sicyon: τῆς τυραννίδος τῆς μελλούσης ἔσεσθαι; διὰ τὴν ἀνδρείαν καὶ τὴν εὐτυχίαν τήν κατὰ πόλεμον; τήν τε χώραν τὴν οἰκείαν; ὁ μὲν δῆμος ὁ τῶν Σικυωνίων, twice. In the *Hellenica Oxyrhynchia* this construction is excessively common. That is the second point.

A third point—a characteristic of all diffuse styles—is the habit of coupling together two words, sometimes adjectives, sometimes adverbs, sometimes verbs, which are more or less connected in meaning, as, for instance: ὡς ἄνδρα δημότην καὶ φαῦλον; υἱὸν ὄντα μαγείρου καὶ τοῦ τυχόντος; ᾠκειοῦτο καὶ προσήγετο. While the words are similar in meaning, two words are used where one would be enough. This again is a marked characteristic of the *Hellenica Oxyrhynchia.* There are, in addition, two or three coincidences of a more special kind. I do not want to make too much of them, but I give them to you for what they are worth; coincidences in actual

words and phrases. Here is one: πολλὰ κακὰ τοὺς πολεμίους ποιήσαντος. Compare with this *Hell. Oxyr.*, xiii, *ad fin.*: Βοιωτοὶ μὲν πολλὰ κακὰ ποιήσαντες τοὺς Φωκέας. Here is another: τὸν ἄνθρωπον παρημέλησε. Compare *Hell. Oxyr.*, xv, 3: τοῦ δὲ ἀνθρώπου τοῦ Καρπασέως. In both passages the word ἄνθρωπος is used in a contemptuous sense. Or again: διετέλεσε διαιτώμενος. Compare *Hell. Oxyr.*, xi, 3: διετέλουν διοικούμενοι. While these last three instances do not come to very much, perhaps—and you cannot expect very much in 195 words—taking it all in all, the coincidences between the fragment and the *Hellenica Oxyrhynchia* are remarkable.

When we come to the longer fragment, the direct coincidences of style between the fragment and the *Hellenica Oxyrhynchia* are neither numerous nor remarkable. They are indeed singularly few. But there are one or two words that occur in the new fragment, one of them more than once, which are favorite expressions of the author of the *Hellenica*. The verb ὑπολαμβάνειν is one (fr. 4, 5, and 12); and again, the verb σπουδάζειν is another (fr. 2; cf. *Hell. Oxyr.*, xiii, 1). There is also the use of διατελεῖν with a participle (fr. 12, διετέλουν ὄντες). Such coincidences are, of course, far too slight to base any case upon. But the important point is this, that when we turn from the direct to the indirect evidence, the case becomes, instead of weak, strong, and overwhelmingly strong. By the indirect evidence I mean the comparison of the style of Diodorus with the style of the *Hellenica Oxyrhynchia*.

Of course, the last thing in the world I should maintain is that if you find a word, a phrase, a sentence in Diodorus, you can be sure that it comes from Ephorus, because again and again you can prove that it is a construction that could not have been used by a Greek writer of the fourth century B.C., but that it belongs to a later period. But our new

fragment proves conclusively that Diodorus did to a large extent incorporate the actual words, phrases, and sentences of his authority, Ephorus. To establish this contention it is only necessary to exhibit side by side the fragments and the sentences in Diodorus that correspond to them.

Fr. 2. [τις] δε τοσουτοις [δια] των εργων

=Diod. xi, 59, 2. τίς δὲ τοῖς ἔργοις ἐν εἰρήνῃ τὴν πατρίδα δυνατὴν κατεσκεύασε τοιούτοις;

Fr. 3. εκεινον μεν υπο της πολεως ητιμασμενον, την δε πολιν δια τας εκεινου πραξεις της μεγιστης τιμης υπο των Ελληνων αξιωθεισαν

=Diod. xi, 59, 3. ἐκεῖνον μὲν ὑπὸ τῆς πόλεως ἠτιμασμένον, τὴν δὲ πόλιν διὰ τὰς ἐκείνου πράξεις ἐπαιρομένην.

Fr. 4. σοφωτατην και [δικαι]οτατην . . . τατην και χαλεποτατην [γενομενη]ν προς εκεινον . . . υπολαμβανουσι

=Diod. *l. c.* σοφωτάτην καὶ ἐπιεικεστάτην χαλεπωτάτην πρὸς ἐκεῖνον εὑρίσκομεν γεγενημένην.

Fr. 6, 7, 8. οθεν παρεξεβημεν. Αθηναιοι δε Κιμωνος του Μιλτιαδου στρατηγουντος εκπλευσαντες εκ Βυζαντιου μετα των συμμαχων Ηιονα την επι Στρυμονι Περσων εχοντων ειλον και Σκυρον ην νησον . . . αυ[του δε πρ[ος Δυκο[μηδην τον β]ασιλεα . . . πρω . . . μαν . . . θησι . . . παραθαλαττιων καλουμενων [πολεων οσ]αι μεν εκ τ[ης Ελλα]δος ησαν απωκισμεναι π[αρα]χρημα συν[επεισε]

=Diod. xi, 59, 4; 60, 1, 2, 4. περὶ μὲν οὖν τῆς Θεμιστοκλέους ἀρετῆς εἰ καὶ πεπλεονάκαμεν παρεκβάντες . . . Ἀθηναῖοι στρατηγὸν ἑλομενοι Κίμωνα τὸν Μιλτίαδου . . . οὗτος δὲ παραλαβὼν τὸν στόλον ἐν Βυζαντίῳ, καὶ καταπλεύσας ἐπὶ πόλιν τὴν ὀνομαζομένην Ἠιόνα, ταύτην μὲν Περσῶν κατεχόντων ἐχειρώσατο, Σκῦρον δὲ Πελασγῶν ἐνοικούντων καὶ Δολόπων ἐξεπολέμησε . . . τῶν παραθαλαττίων πόλεων ὅσαι μέν ἦσαν ἐκ

τῆς Ἑλλάδος ἀπῳκισμέναι ταύτας παραχρῆμα συνέπεισεν ἀποστῆναι τῶν Περσῶν.

Fr. 9, 10. [Κιμων πυνθανομενος το]ν τ[ων Περσων στολο]ν περι [την Κυπρον συ]ντετα[χθαι διακοσι]αις πεν[τηκοντα π]ρ[ος] τρια[κοσιας] και τετταρα[κοντα] παραταχθεισας δε πολυν χρονον πολλας μεν των κινδονευουσων βαρβαρικων νεων διεφθειρεν· εκατον δ αυτοις ανδρασιν ειλε ζωγρησας τον . . .

=Diod. xi, 60, 6. Κίμων δὲ πυνθανόμενος τὸν στόλον τῶν Περσῶν διατρίβειν περὶ τὴν Κύπρον, καὶ πλεύσας ἐπὶ τοὺς βαρβάρους, ἐναυμάχησε διακοσίαις καὶ πεντήκοντα ναυσὶ πρὸς τριακοσίας καὶ τετταράκοντα . . . καὶ πολλὰς μὲν τῶν ἐναντίων ναῦς διέφθειραν, πλείους δὲ τῶν ἑκατὸν σὺν αὐτοῖς τοῖς ἀνδράσιν εἷλον.

Fr. 11. [τον με]ν [στρατηγο]ν αυτων [Φερενδατη]ν αδελ-[φιδουν οντ]α του βασ[ιλεως εν τη]σκηνη

=Diod. xi, 61, 3. Καὶ τὸν στρατηγὸν τῶν βαρβάρων τὸν ἕτερον Φερενδάτην, ἀδελφιδοῦν τοῦ βασιλέως ἐν τῇ σκηνῇ καταλαβόντες ἐφόνευσαν.

Fr. 12, 13. διετελουν οντες· ωστε νομιζοντες απο της ηπειρου την εφοδον αυτοις γεγογεναι των πολεμιων προς τας ναυς εφευγον υπολαμβανοντες αυτοις ειναι φιλιας ου δη πολλοι μεν υπο των καταλειφθεντων εκει φυλακων απεθνησκον εν τη νυκτι πολλοι δε ζωντες ηλισκοντο περιπιπτοντες τοις Ελλησιν δια την απορiαν οπου τραποιντο και τον . . .

=Diod. διὸ καὶ νομίσαντες ἀπὸ τῆς ἠπείρου τὴν ἐπιφορὰν εἶναι τῶν πολεμίων, πρὸς τὰς ναῦς ὡς πρὸς φιλίας ἔφευγον. τῆς δὲ νυκτὸς οὔσης ασελήνου καὶ σκοτεινῆς συνέβαινε, τὴν ἄγνοιαν πολὺ μᾶλλον αὔξεσθαι καὶ μηδένα τάληθὲς δύνασθαι ἰδεῖν.

Now, the question arises: What are the passages in Diodorus in which we should expect to find the actual words of Ephorus? The more concise the passage in Diodorus,

the more probable it is that he is not using the language of Ephorus, because the more he cuts him down, the more he would depart from his actual words. On the other hand, the fuller the treatment of Diodorus is, the greater is the probability that you have there a good deal, at least, of the language of Ephorus. But we can go beyond that. It was pointed out some few years ago by a German scholar, Laqueur, that the προοίμια, or prefaces, which Diodorus prefixes to each Book of his History, must have been copied out from Ephorus, on the ground that when Diodorus gets beyond the part of his history that he took from Ephorus, and consequently has to compose προοίμια of his own, they are lamentable stuff. Hence we may look for the actual words of Ephorus in these prefaces. Again, when Diodorus is dealing with a political situation, with a question of policy or a political stratagem, or something else of the kind, there is a strong probability that in the main he will give us the language of Ephorus, because, being a writer of very mean intelligence (I am not sure that he was not the most stupid man that ever wrote history), he was much too stupid to conceive for himself a political situation. Therefore, the more difficult the situation, the greater the probability that we have Ephorus and not Diodorus. Once more, there are the appreciations of character, *e.g.*, that of Aristides (Diod. xi, 44–47), which we know to have been a marked feature in Ephorus' work. These are the kind of passages which we should expect to come from Ephorus, and in which we should expect to find coincidences of style between Diodorus and the *Hellenica*.

Now let us turn to the actual coincidences, and see what we have. At the very end of the *Hellenica Oxyrhynchia*, in a passage in which the author is speaking of the breadth of Asia Minor, the following words occur: ἀκούων ταύτην τὴν χώραν διατείνειν ὥσπερ ταινίαν στενὴν ἀρξαμένην ἀπὸ τῆς Ποντικῆς

θαλάττης μέχρι Κιλικίας καὶ Φοινίκης. In Diodorus (xii, 50, 2) we find an exactly similar phrase: ἡ μὲν γὰρ παραθαλάττιος αὐτῆς ἀπὸ τῆς Ἀβδηριτῶν χώρας τὴν ἀρχὴν ἔχουσα διέτεινε μέχρι τοῦ Ἴστρου ποταμοῦ.

A still more striking coincidence is to be found in the passage in which the prosperity of the Thebans during the Peloponnesian War is described as follows (*Hell. Oxyr.*, xii, 3): ἐπέδοσαν οἱ Θηβαῖοι πολὺ πρὸς εὐδαιμονίαν ὁλόκληρον. With this we may compare Diodorus xii, 1, 4, a passage in the προοίμιον to Book xii: πολλὴν ἐπίδοσιν ἐλαβεν ἡ Ἑλλὰς πρὸς τὴν εὐδαιμονίαν. The word ὁλόκληρον occurs at the beginning of this same passage. Again, at the very beginning of the *Hellenica* we have the phrase κοινωσάμενος ἐν ἀπορρήτῳ τῇ βουλῇ. To this there is a parallel twice over in Diodorus (xi, 39, 5; xi, 42, 5): εἰ ἀπορρήτοις τῇ βουλῇ προεῖπεν. As both these are passages dealing with a political situation, we can be sure that the phrase comes from Ephorus.

Again, we have the adjective ἀδρότατα used in a figurative sense at the beginning of Chapter 4 of the *Hellenica*. In Diodorus we find ἄδρος, in the positive degree, similarly used in a figurative sense more than once. That is not a very common use of the term.

Or again, Τιμοκράτει διελέχθησαν (*Hell. Oxyr.*, ii, 2). With this we may compare διελέχθησαν Ἱπποκράτει (Diod., xii, 69, 1). In both passages διαλεχθῆναι is used in the same sense of "conferring with" or "intriguing with."

Again, twice over in the *Hellenica* we have the word ἐξετασμός, a review of troops, in place of the more usual ἐξέτασις. It occurs in Diodorus three or four times.

Another phrase that meets us in the second line of the *Hellenica* is οὐ μετὰ τῆς τοῦ δήμου γνώμης. Its equivalent, ἀπὸ τῆς τοῦ δήμου γνώμης, is frequent in Diodorus in passages describing a political situation.

Let us now turn to an interesting group of words, because they belong to the terminology of politics. In the *Hellenica* (i, 2), the conservative party at Athens is described as ὅσοι γνώριμοι καὶ χαρίεντες ἦσαν. Χαρίεντες was noted at once, when the fragment was discovered, as a new term—an unusual term—but you have it in Diodorus, two or three times over (xiii, 104, 6, and xiv, 5, 7), though in the comparative degree. In the same passage in the *Hellenica* (i, 3), ἐπιεικεῖς is used with a political connotation. This use is found in Diodorus (xiii, 53, 1).

Φρονεῖν τὰ Λακεδαιμονίων (*Hell. Oxyr.*, xii, 1) is thoroughly Diodorean, and ἑταιρεία, in the same passage, is also found in Diodorus. Though μέρος, in the sense of a political party, is not found in Diodorus, μερίς is. With συντελούντων εἰς τὰς Θήβας (xi, 3) we may compare συντελεία, in the sense of a confederacy, which is common in Diodorus.

If we turn from the terminology of politics to that of warfare we find the following words common to the *Hellenica* and Diodorus: δῃοῦν, πορθεῖν, λεηλατεῖν, ἐνεδρεύειν, κατὰ κράτος ἑλεῖν, συντεταγμένοι. All of these are, of course, common enough words. Among other words or phrases which are found both in the *Hellenica Oxyrhynchia* and Diodorus we may point to σκάφος, προέχειν, ἀλλοτρίως or δυσμενῶς ἔχειν or διακεῖσθαι, παραθαλαττίδιος, καθ' ὑπερβολήν, and ἀντιπράττειν. Τοῦτο τὸ τέλος ἔλαβεν, the phrase with which the revolution at Rhodes is dismissed, is constantly used by Diodorus for the purpose of concluding an episode. Το ἀμφισβητήσιμος χώρα (*Hell. Oxyr.*, xiii, 3) there is a sufficiently close parallel in Diodorus (xi, 79, 1): περὶ χώρας Ὁμόρου ἀμφισβήτησις. Finally, there are words such as σπουδάζειν, παροξύνειν, ὑπολαμβάνειν, καταπλαγείς, προθυμία, which are great favorites with both writers.

I venture, therefore, to think that when you consider the material afforded by the two new fragments in regard to the question of scale, of treatment, and of style, you will find the evidence in favor of the hypothesis that Ephorus is the author of the *Hellenica Oxyrhynchia* to be overwhelming.

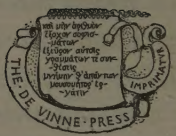
One question which is of the utmost interest remains to be answered, and that is the question of the style of Ephorus. How far can we determine from Diodorus the style of Ephorus? There are certain passages that may be picked out, mostly from the eleventh book of Diodorus, where I think we may be as certain as we can be that we have before us the actual words of Ephorus, partly because in some places the style is much too good to have been invented by the brain of Diodorus. The passage (xi, 39 and 40) which describes the way in which Themistocles outwitted the Spartans when they wished to prevent the rebuilding of the walls of Athens, is one. I think that, if you will read that through, you will see that a great deal of the language which is used must come straight from Ephorus. Again, there is the story of the way in which Themistocles built the harbor of Piræus (xi, 41–43). The story is told at great length, and I am disposed to think that the whole passage has been taken from Ephorus, *verbatim et literatim,* with the alteration of a few words and phrases. Again, there is the passage in which he describes the transference of the hegemony from Sparta to Athens (xi, 50). Here, too, I think there can be no question that we have the actual Ephorus. The passage (xi, 54, 55) in which he describes the banishment of Themistocles is another instance from the same book. There is much, too, that comes from the pen of Ephorus in the account of the siege of Ithome (xi, 64). Two passages from later books are interesting. One (xii, 58) is the passage in which he describes the outbreak

of the plague at Athens, and explains its origin. The language is much too technical and much too good for Diodorus. Clearly he got the whole passage straight out of Ephorus. He certainly did not get it out of Thucydides. Finally there is a passage (xii, 38–40) which we know from Diodorus himself to be derived from Ephorus, the account of the causes of the Peloponnesian War, and the story of the advice given to Pericles by the young Alcibiades. This passage, if carefully examined, will, I think, give an excellent idea of the style of Ephorus.

If we read through these passages we shall find words and phrases which carry on the face of them the stamp and impress of his style. In the second passage (xi, 41–43) we have μετὰ τῶν δυναμένων καὶ βλάπτειν καὶ ὠφελεῖν τὰ μέγιστα—βούλεται γένεσθαι σύμβουλός τε καὶ εἰσηγητής—τούτους ὁρῶν ἀμιλλωμένους περὶ δόξης καὶ πρωτείων—τὴν δεινότητα καὶ μεγαλοφροσύνην τἀνδρός—κἂν αὕτη κρίνῃ τὰ δυνατὰ λέγειν καὶ συμφέροντα. In the next passage (xi, 50) we find τούς τε τῶν ἰδιωτῶν οἴκους πολλὴν ἐπίδοσιν λήψεσθαι πρὸς εὐδαιμονίαν—τῆς γερουσίας συνεδρευούσης περὶ τούτων—μὴ συμφέρειν γὰρ τῇ Σπάρτῃ τῆς θαλάττης ἀμφισβητεῖν. These last words afford an example of a construction, a clause in *oratio obliqua* introduced by γάρ, which is extraordinarily frequent both in the *Hellenica Oxyrhynchia* and in those passages in Diodorus which appear to have been taken from Ephorus with little change. In the next passage (xi, 54, 55) we have διελέγοντο δὲ καὶ τοῖς ἐχθροῖς τοῦ Θεμιστοκλέους, παροξύνοντες αὐτούς πρὸς τὴν κατηγορίαν (διελέγοντο and παροξύνοντες are both characteristic of the *Hellenica*)—μετὰ δὲ ταῦτα οἱ μὲν φοβηθέντες αὐτοῦ τὴν ὑπεροχήν, οἱ δὲ φθονήσαντες τῇ δόξῃ, τῶν μὲν εὐεργεσίων ἐπελάθοντο, τὴν δ' ἰσχὺν αὐτοῦ καὶ τὸ φρόνημα ταπεινοῦν ἔσπευδον (ἔσπευδον, again, is characteristic of the *Hellenica* and of the Ephorean passages in Diodorus). In the passage that relates to the siege of Ithome there is a

phrase that no one would think of attributing to the inventive powers of Diodorus—τὴν ἔχθραν ἐξεπύρσευον (xi, 64, 3). The passage in Book xii, which gives Ephorus' account of the causes of the Peloponnesian War, has probably suffered but little from the touch of Diodorus. Sections 2, 3, and 4 of Chapter 38 are possibly almost intact. These passages have been selected from two books only, and in these two books there are many more passages that have as good a claim as those selected to give us the actual words of Ephorus. The newest fragment affords indisputable evidence of the extent to which the language of his authority was reproduced by Diodorus in his appreciation of Themistocles (Diod. xi, 59 compared with fragments 2, 3, 4). It may safely be assumed that we have the genuine style of Ephorus in the ἔπαινος of Aristides and the βλασφημία of Pausanias (xi, 46, 47). Another passage in Book xi in which we may detect again and again the hand of Ephorus is one which, on the ground of its contents, may fairly rank among the most valuable contributions of Diodorus to our knowledge of this period of Greek history. It is the passage (xi, 79–83) in which the story of the battles of Tanagra and Œnophyta is told, and the political conditions of Bœotia described. It is significant that the two passages in ancient literature which give us the fullest information as to the Bœotian League are this passage and the famous Chapter 11 of the *Hellenica Oxyrhynchia.* If any one will be at pains to work through the remaining books of Diodorus that are derived from Ephorus—xiii, xiv, and xv—on the lines that I have indicated for Books xi and xii, he will, I have little doubt, find it no impossible task to recover, in passage after passage, the *ipsissima verba* of the famous historian.

Edward M. Walker.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